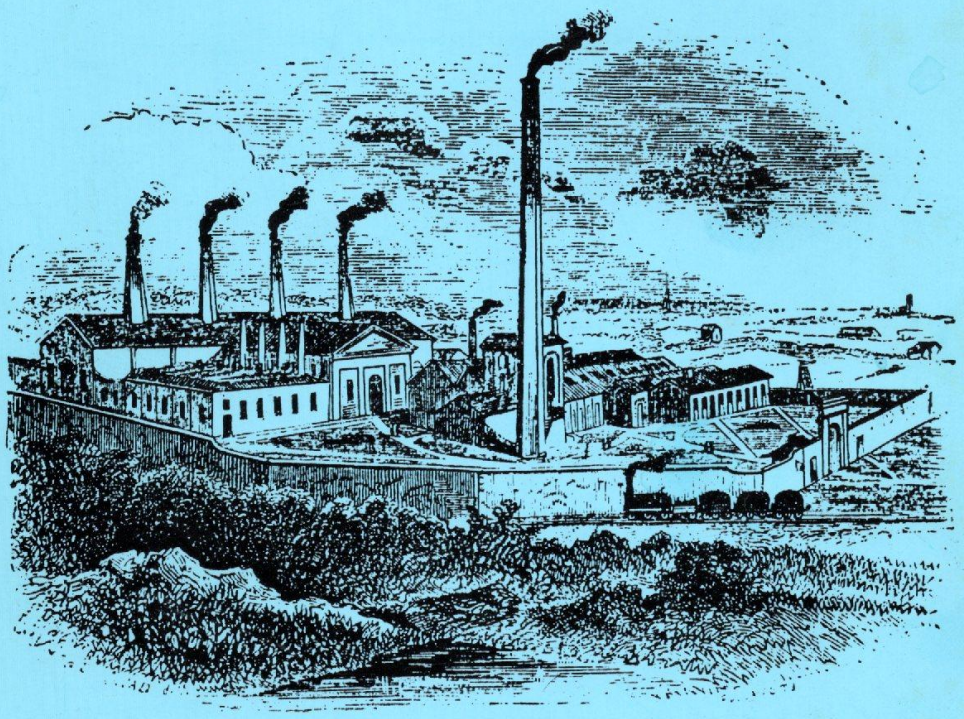
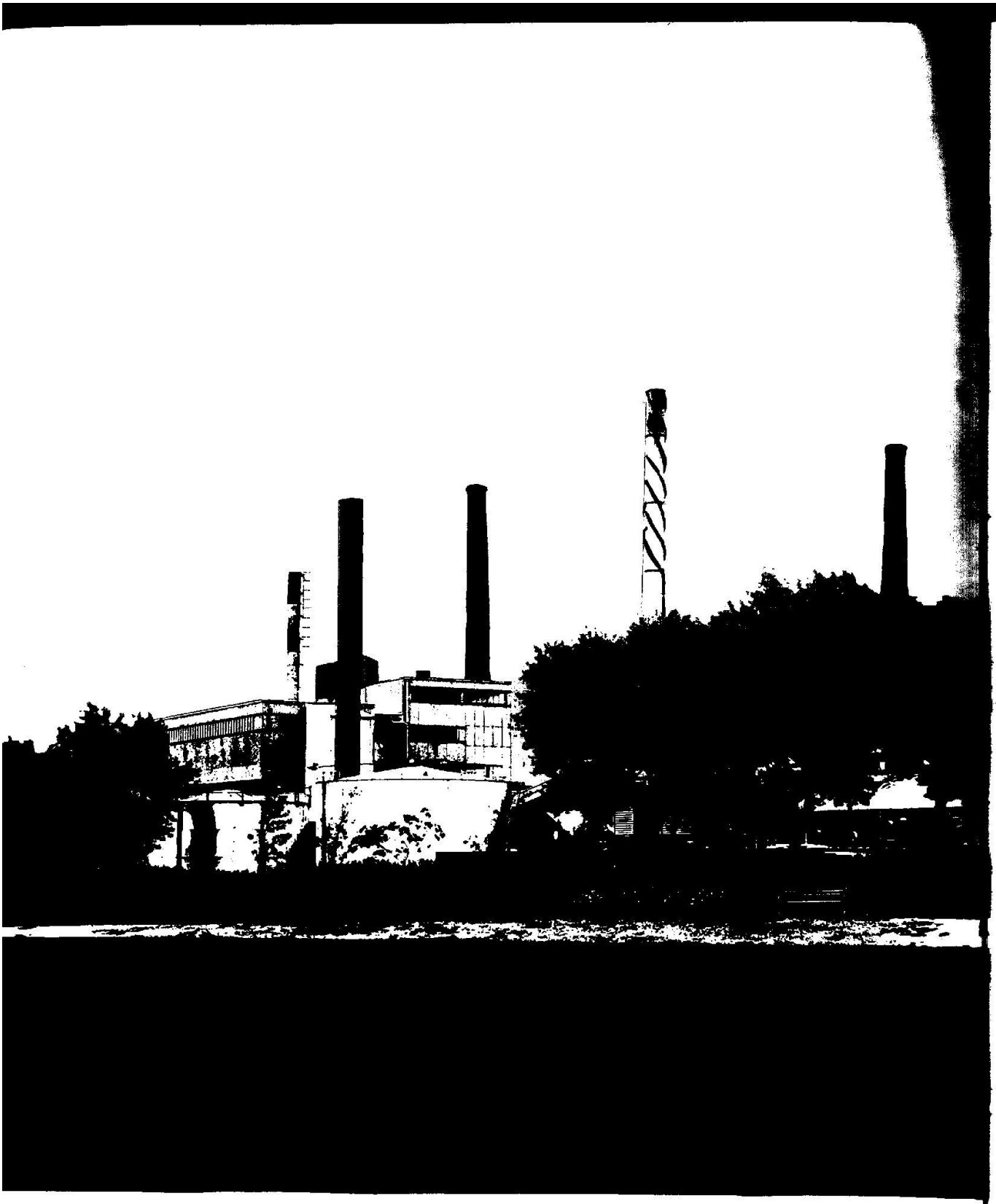
THE HISTORY
OF
FORSTER'S GLASS CO. LTD.



ST. HELENS
ENGLAND



COVER: THE POCKET NOOK SITE IN 1843

FROM :: THE MIRROR " 11th MARCH, 1843

£3

THE HISTORY
OF
FORSTER'S GLASS CO. LTD.

ST. HELENS
ENGLAND

FOREWORD

It was with great pride that I accepted an invitation to write this introduction to the history of the company which was founded by my grandfather, John Forster, and built up by his sons.

Although it became a public company in 1919, Forster's always remained a family concern in the best sense of that phrase. I can remember visiting the 'works' as a small boy in my grandfather's life-time, and from those early days until my retirement in 1963 my most vivid recollection is of the friendly and happy relationship which existed between all levels of management and men. This was borne out by the long service of many who worked at Forster's, and by the family continuity which was strongly maintained on the shop floor as well as in the boardroom.

There were many who spent all their working lives in the loyal service of the company. One whom I would single out for special mention is Harold Moss, whom my father engaged as a boy to work in the original small office, and who remained with the company for forty-eight years until his retirement, for the last twenty-eight of those years Mr. Moss was Company Secretary.

When it was decided that this History should be written, Mr. Moss's intimate knowledge of the company's early years proved invaluable. Three other former members of Forster's staff — Dr. C.J. Peddle, Dr. A. Cousen and Mr. A.D. Morris — joined Mr. Moss in this considerable undertaking. The story which follows was compiled from their personal papers and from many widely-scattered records painstakingly researched. I should like to express my own grateful thanks to them for their efforts.

Michael L. Forster.

THE FOUNDER

ALDERMAN JOHN FORSTER, O.B.E., J.P.

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CHAPTER 1

The Founder
Alderman John Forster, O.B.E., J.P.

An old proverb tells us that some men are born great and that others have greatness thrust upon them. St. Helens has been the centre of a flourishing glass manufacture since the last years of the 18th century, and as years went by, sons succeeded fathers in the ownership of several of the glass concerns in the vicinity, being born into glass manufacture so to speak. This could not be said of one prominent St. Helens citizen — Alderman John Forster, O.B.E., J.P., — the Founder of the "Forster" firm.

Mr. John Forster was born in Traverse Street, Parr Mount St. Helens, on 23rd December 1853. He was educated at Holy Trinity and Moorflat Schools, and later at Farnworth Grammar School where he took many prizes. In 1868 he was apprenticed as an engineer with Robinson Cook & Company, Atlas Foundry, St. Helens, passing through the patternmaking, fitting and turning departments and finishing in the drawing offices.

On the death of an elder brother in 1876, Mr. Forster went into the boiler-making department in the Atlas Foundry to assist his father who had charge of that branch of the business, and after a period of two years, he, in partnership with his eldest brother, started business under the style of D. & J. Forster at the Navigation Boiler Works, Bridgewater Street, St. Helens, near to the site occupied by the offices of Pilkington Brothers. This partnership was later dissolved, Mr. David Forster starting a boiler works at Widnes, while Mr. John Forster continued the St. Helens business. In 1890 the lease of the Navigation works expired and the premises were acquired by Pilkingtons for expansion while Mr. John Forster moved to Atlas Street where he carried on his business as a constructional engineer in new and larger premises.

It is perhaps an item of local interest that his Company undertook the fabrication of the standards required to support the overhead cables for the tramway system in St. Helens. Mr. Forster was married in 1878 and after residing for about ten years in Hall Street, he moved to the Cowley Hill district of the town where he had built a house. He was a member of the Wesleyan body, and always took a deep interest in religious and social questions. He occupied all the chief offices open to laymen in the St. Helens Wesleyan church, and was for several years one of the managers and treasurers of the Wesleyan day schools; for four years he was a circuit steward and for nearly twenty years a local preacher in the St. Helens circuit.

Mr. Forster's political education commenced at an early age he having long been a student of political questions. On the incorporation of the Borough in 1869, he canvassed for one of the candidates at the first election of the Council. He had distinct recollections of Mr. Gladstone opening his campaign at the Volunteer Hall and of his great speech on the Irish Church question. In 1874 he joined the old Liberal club in Hardshaw Street and worked continuously for the party. In 1884 he was invited to stand for Hardshaw ward and was elected. He continued to serve on the Town Council for over forty years during which time he held office as Mayor of St. Helens and became a Justice of the Peace. Previously he was elected as Liberal candidate for St. Helens in the Parliamentary election of 1895, but was unsuccessful.

He was "His Imperial Chinese Majesty's Consul General" in Great Britain, being appointed in December 1908, and in 1914 the then President of the Chinese Republic conferred on him the Third Order of Prosperity. For his public services in the 1914/18 war he was awarded the O.B.E. Finally in recognition of his services to St. Helens he was made a Freeman of the Borough in 1924.

Mr. Forster died on the 30th December 1927; the story of his turning from constructional engineering to boiler-making to the production of glass bottles is one well worth recording, for it is the story of a pioneer imbued with an idea and persevering in the face of a host of difficulties.

CHAPTER 2

From Engineering to Glass

The last few years of the nineteenth century saw the beginning of a world wide revolution in the manner of making glass bottles. For many centuries bottles were made "by hand", being blown to shape by the mouth of the operator i.e. their production was wholly dependent upon the skill of the workman who fashioned them from the molten glass. Such bottles, being wholly dependent upon the craftsmen for their fashioning, were said to be "hand made" or "mouth blown" and the speed of production was slow, only from one to three bottles per minute being possible according to the size of the bottle.

In many directions in the nineteenth century invention was a keyword and from the early years of this century inventors were busy in the glass bottle industry devising machines to replace the mouth blowing of bottles by some mechanical means. In this country as early as 1859, the first patent of a glass bottle making machine was granted to Alexander Mein of Glasgow, and other patents followed at intervals. Unfortunately none of these patents met with any practical application until the late 1880's when a machine was patented in 1886 by H.M. Ashley and became successful. The first Ashley machine was built in Knottingley and worked successfully in 1887 producing bottles at the works of Messrs. Sykes & McVey at Castleford in Yorkshire, and thus became the first machine in the whole world ever to produce glass bottles.

Within a few years, Ashley machines were operating with success at other glass works in both Lancashire and Yorkshire and so pioneered the start of the machine age in glass bottle manufacture. Although these machines did away with the mouth blowing of the bottle, they were dependent upon an operator to gather glass for them just as for mouth blown ware, and upon other operators to work the various machine parts which did the blowing. As the human element was partly involved, these machines were referred to as "semi automatic" and ware produced on them was known as "semi automatic ware". By the turn of the century a large proportion of the dark green bottles for beer manufactured in this country was made on semi automatic machines.

While the Ashley bottle machine was the only successful semi-automatic glass blowing machine in this country before 1900, on the Continent an equally successful machine was devised before that date by Claude Boucher, a French engineer, and operated on a commercial scale at the Cognac glass works in 1897. Boucher began his experiments in 1892 five or six years after Ashley and when success was assured in 1898, he communicated the news to several of his engineering friends and acquaintances in Great Britain, France, Germany, Belgium etc., and invited them to see the machine in action.

Amongst those friends was John Forster of St. Helens who was so impressed by the performance of the machine that he was determined to acquire the manufacturing rights of it in order to market it for bottle making in Great Britain. He purchased the patent rights in 1899, but found difficulty in persuading bottle manufacturers in England to make a trial of the Boucher semi automatic machine in their works. They were sceptical about its ability to produce bottles successfully and no manufacturer was prepared to install one. Confident that the Boucher machine was all that its inventor claimed it to be and determined to show its capabilities, John Forster decided to add to his other activites that of glass bottle manufacture. In the year 1900 at his engineering and boiler making works in Atlas Street, St. Helens, he built a glass furnace, melted dark green glass in it, and, employing the semi-automatic Boucher machine, made glass bottles on it successfully.

Having by practical demonstration confounded the critics of the Boucher machine and impressed by the possibilities in front of him, John Forster decided to enter the domain of glass bottle manufacture himself, using semi automatic machine methods. So accurate was his judgement and so great his faith in the machine which he developed from the original Boucher machine, that gradually the firm of John Forster & Co., changed its character, and the manufacture of glass bottles became more important than the original and formerly sole activity of engineering and boiler-making.

The premises at Atlas Street became known as Atlas Glass Works, St. Helens, an address which has been in use from 1900 to the present day.

CHAPTER 3

Early Days in Semi-Automatic Production

The entry of John Forster into the manufacture of glass bottles involved two major activities. In the first place there was the task of melting dark green glass and from it producing bottles on a commercial scale, using the semi-automatic Boucher machine. The second activity was the building of more Boucher machines in his engineering workshops, and the trying out of improvements to these machines developed from practical experience in the glass house. Within three of four years, Boucher machines of improved design were in operation at Atlas Street so successfully that the installation of similar machines was under consideration by other glass bottle manufacturers wishing to introduce semi-automatic methods.

John Forster's faith in his new enterprise continued unabated and success followed: on 15th March 1905 the private company of Forster and Sons Limited, glass bottle manufacturers, was formed but while the business steadily increased it was faced with many difficulties.

There were at the time two other well established bottle works in St. Helens, both in the process of replacing the old hand-made methods by semi automatic machine manufacture and both better situated as regards transport than Atlas Street. It was always a serious handicap to the Atlas Street works that all the raw materials used in the manufacture of the glass and all the fuel for the furnace and boilers had to be brought by road in horse drawn carts and lorries, as no rail or canal facilities were available in the works.

In similar fashion, all bottles sent away from the works had to be transported by road in the first place. It became a familiar sight in Atlas Street to see a cart piled high with bales of bottles packed in straw and pulled by powerful horses setting out for the docks in Liverpool or some other destination. Tradition has it that when times were bad, as they sometimes were in those days of intense competition in the bottle industry, the glass blowers would stand and watch the welcome sight of the straining horses setting off on their journey with the remark: "Well, we shall get paid this week at any rate"

Another difficulty, and no easy one to overcome in a venture setting out from scratch, was the building of the furnace for the melting of the glass and the firing of it by means of the manually operated steam gas producers then in vogue. The correct choice of the best refractory blocks for building the furnace had to be made to learned by experience and the best mixtures of the raw materials worked out as being the most suitable for melting into glass. These mixtures of raw materials were composed chiefly of sand, soda ash, or salt cake, and limestone, and were mixed by hand shovelling. As a rule a proportion of broken glass (cullet) was incorporated with the raw materials before the mixture was thrown into the furnace and melted down into glass.

Very little technical knowledge regarding glass manufacture was available at that period and bottle manufacturers having such knowledge guarded it jealously. Newcomers into the industry had to learn largely from experience and more often than not methods of trial and error were the order of the day. Amongst the major problems facing the newcomer to glass manufacture was the recruiting and training of labour and particularly was this the case during the transitional period from hand blown production to manufacture upon semi automatic machines. The old hand blown glass operative, besides being a highly skilled and well paid craftsman, was also very conservative indeed in his outlook. He demanded a long apprenticeship to his craft and every bottle-making district had its own Protection Society or Trades Unions.

The doctrine of the "closed shop", as we know it today, was rigidly practised by the members of these Protection Societies and they resented very bitterly the coming of the machine into their business. As a rule, hand blown operatives refused to work in the same "shop" as that in which a machine was working and firms which employed both types of production had to build separate "shops" each furnished with its own furnace. In 1906, for example, the Yorkshire

Glass Bottle Makers United Protection Society had a rule which stated:—

"Bottle making machines shall not be put into the bottle house amongst the bottle hands, and members shall not be displaced by machines."

The Forster concern, never having been in mouth-blown bottle production, did not have this trouble of Union interference at first, when they came to recruit a labour force for their semi automatic manufacture. Later when the semi automatic machine operators themselves began to band into Unions, labour troubles regarding wages and conditions were not unknown, for the machine glass operators on occasion proved themselves as autocratic, independent and stubborn as their brethren in the mouth blown Unions.

Autocratic and independent as his glass blowers were, on one famous occasion John Forster proved himself more autocratic and independent as a glass master. The story goes that a deputation of glass hands went to see him demanding an immediate rise in wages. They refused to listen to anything he had to say and presented him with the ultimatum that he must grant their demands or they would strike. John Forster's reply to this was to proceed to the gas producer pit and draw the producer fires with his own hands, thus shutting down the furnace and putting a stop to all production on it. He then told the men to come back to work when they were in the mood to listen and not to dictate.

A battle of wills went on for two or three weeks during which time the opportunity was taken to have the furnace repaired and relit. When the men returned at the end of the stoppage and in a less dictatorial mood, he "chastised" them, as one of them said at the time, by granting them unasked a rise in wages, "but then" as the same commentator remarked, "Mr. John had to show us who was boss".

In spite of occasional rifts in the lute, a feeling of great mutual respect grew up between John Forster and his work people and relations between Management and men at Atlas Street were notably happy ones. These happy relations continued all through the years of the 1914—18 war and afterwards when Forster & Sons became a Public Company.

Although the difficulties to be faced were many, Forster & Sons contrived to overcome them and to hold its own. Slowly its production expanded and it is on record that by 1907 as many as seven of the improved Boucher machines were in operation round the single furnace at Atlas Street. Because they were built in Forster works at Atlas Street, it became customary to refer to these semi automatic machines of improved design as Forster machines.

From time to time further improvements in the machines were patented and incorporated. One fitment to the Forster machine enabled it to make a bottle with an internal screw. Previously any bottle, whether mouth blown or made on a semi automatic machine, had to have its internal screw fashioned by a hand-made method. Thus the Forster machine takes its place in glass history as being not only the first machine in the world to make a glass bottle with an internal screw but probably also one of the best for a long time.

The reputation of these machines soon spread beyond St. Helens and many other glass manufacturers placed orders for them. The success of his machines, and of his glass works, won international recognition for John Forster and his Company, and in addition to the orders for machines from his competitors in this country, enquiries were received from overseas not only for the Forster machines but also for schemes for complete glass works.

Forster's designed and supervised the construction and commissioning of glass works in China and South Africa, and received similar enquiries from Argentina, Australia, Canada, India, Italy and Turkey.

The phrase "export to live" may not have been used in those days, but the importance of export business was recognised by John Forster, and is evidenced by the following extract from the Minute Book:

"2nd November 1905

Resolved that all salaries and accounts be paid up to date from the money sent from China for the glass contract"

In 1908 the glass works of Youngers of Alloa, was completely equipped with Forster machines. Unfortunately records for these days are no longer available, but other known users of the Forster machines were Bagley and Company, Kinghorn Bottle Company, Brooks of Leeds, Walkers of Irvine, and United Kingdom Glass Company of London.

In June 1915 regarding an enquiry for machines from Allsopps of Burton, it is minuted that:

"owing to the loss of men who had enlisted, we were unable to make the machines required during the duration of the war".

but later in September 1915 concerning an order from a South African group it is minuted that:—

"we had agreed to supply them with 24 machines in accordance with the particulars stated in their order dated 2nd September, 1915".

CHAPTER 4

Move to Pocket Nook

By 1908 Forster & Sons were well established, not only as the manufacturers of the successful Forster semi automatic machine, but also as one of the leading glass bottle manufacturers in this country. Expansion at Atlas Street was not possible because of the limitations in space and also because of the restricted nature of the transport facilities.

Accordingly, about this time they began to acquire land and buildings in the old disused Union Plate Glass Co.'s works in nearby Pocket Nook. Although the Union Plate Glass Works had been defunct for many years the buildings were still serviceable and quite capable of housing further glass melting furnaces and providing room for their attendant gas producers, batch mixing rooms, annealing lehrs and the other equipment required.

Before the end of 1912, three new furnaces (Nos. 2, 3 and 4) had been constructed in the factory at Pocket Nook, each equipped with semi automatic Forster machines, and although bottles continued to be made in the No. 1 furnace at Atlas Street, the main production activity was centred at Pocket Nook. Pan lehrs were installed to cater for the annealing of the production. These were a great advance on the old-fashioned annealing kilns into which the hot bottles were sealed and allowed to cool down overnight. A boiler house was installed to provide steam for the steam blown gas producers of the Siemens type which were fitted to each of these new furnaces.

Another feature at Pocket Nook was the provision of a centralised batch mixing department where raw materials could be stored under cover and after mixing conveniently despatched to the melting end stages of each of the furnaces by means of an overhead transport system. During the mixing process a proportion of broken glass (cullet) was always mixed in with the raw batch materials on the grounds of economy as well as making for easier melting of the glass.

In addition, the Pocket Nook site was well served by a canal as well as by two railway lines, one being the old London and North Western Railway and the other the old Great Central Railway. Both these lines did yeomen service for Forster's Glass over the years, and when later in 1923 Forster's established their London depot and private railway sidings at the Marylebone terminus of the Great Central Railway, a daily direct express goods service was possible between the Pocket Nook works and the London depot. By this means bottles loaded overnight in St. Helens could be delivered to London customers shortly after 6.00 a.m. the following day. A further benefit was the easier delivery of raw materials and fuel direct into the works, thus avoiding one of the bottle necks of manufacture at Atlas Street.

Although the acquisition of part of the old Union Plate Works at Pocket Nook and the construction there of three new furnaces meant that the bulk of bottle production was now centred at Pocket Nook, the building of Forster machines continued in the engineering shops at Atlas Street. The supervision of the whole factory, both at Pocket Nook and at Atlas Street, was carried out from Atlas Street where the main offices were situated, and even after the cessation of production at Atlas Street, for many years the offices were referred to as "No. 1" by all works personnel.

The works at Atlas Street before the extension to Pocket Nook comprised a very compact little factory. The offices which housed the directors, a small managerial staff and a clerical staff, overlooked the small glass furnace with its thirty or forty operators working around it, which, with its ruddy glow, made a cheery sight, especially on wintry evenings.

The operators worked in two shifts, and as was customary in glass works of those days,

the day shift workers, particularly the carry off boys, enlivened the proceedings by singing all the popular songs of the day. This "music while you work" was denied to workers on the night shift because of complaints from the neighbouring houses, but when the Pocket Nook works was established, singing even at night became quite a feature as no homes were near.

It was amusing too at Pocket Nook to hear the lehr boys "singing for pans" when they wanted pans moving from one end of the annealing lehr to the other. "Another pan wanted here" sung in notes ranging up and down the scale and ringing through the vaulted tankhouse roof had quite an operatic flavour. A works manager of the time said it always pleased him when he walked into the tankhouse to hear men singing because it was a token that everything was ship-shape and going satisfactorily.

The coming of the war in 1914 found Forster & Sons well established as a bottle making firm with four furnaces available for production upon semi automatic machines. This manufacture was mainly concerned with dark green glass bottles for beer, wines and spirits, but, when occasion required, one furnace was employed melting pale green glass for the production of mineral water bottles and the like.

The war brought the firm many problems not the least of which was the loss of skilled operatives called up in the early days of the war because they were Army or Navy reservists. Despite the many problems, bottle production continued in full swing all through the four years of war. In addition, the engineering shops were turned over at the end of 1915 to the manufacture of 18 pounder and 6 inch shells, but unfortunately no records are available from which a detailed account can be given concerning this activity.

CHAPTER 5

Development of Automatic Machine Production

The years prior to the start of the war in 1914 had seen the firm establishment of semi automatic glass bottle production, not only in Europe, but also in the United States. From the turn of the century however this semi automatic development found a formidable rival in the fully automatic machine first invented in the U.S.A. With this type of bottle production the supply of glass to the machine, as well as the fashioning of the bottle, was automatic, and as fully automatic manufacture was later to play so big a part in the future of Forster's Glass, it will not be out of place to make a first reference to it at this stage.

In 1904, after five or six years of experimenting, Michael J. Owens, an American glass engineer, brought into successful commercial operation a fully automatic bottle making machine and in 1905 such a machine was producing, at Toledo in the United States, bottles at the rate of ten or twelve per minute. This rate of production which was three or four times that of the fastest semi automatic machine or mouth blown process astonished the whole glass world.

The coming of the Owens machine exerted a profound influence upon the bottle making industry throughout the world. In the States its increased speed of production with a reduced labour force bade fair to replace all other methods of bottle making.

Spurred by its success in America, its inventors determined to establish its use in Europe. With this end in view land was bought at Old Trafford in Manchester and in 1906 a model factory was built there. Two glass furnaces were built and on each a six arm fully automatic Owens machine was installed. Operations began in April 1907 and were so successful that plans were made by the American interests concerned to erect further furnaces up to twenty in number with the object of capturing the whole European market in bottles.

The glass manufacturers throughout Europe quickly realised the threat to their trade because of the tremendous potential output of such a new factory. Accordingly before the end of 1907 a number of them banded together and bought up the European rights of the Owens automatic machine for the price of £600,000. A European organisation with headquarters in Germany was formed to exploit the control and installation of Owens machines in Europe.

Ten countries had a stake in this parent organisation and in each an Association was formed

comprised of firms contributing to the purchase of the patent rights and charged with the development of the Owens machine in that country.

Forster & Sons were not amongst the seven British firms that purchased rights in the Owens machine organisation in 1907. In company with the majority of the smaller glass bottle manufacturers, they realised the limitations, as well as the potentialities of the Owens machine, which demanded large orders of the same type of bottle if it were to be worked economically. In Britain in these days glass bottle manufacture subsisted largely on numerous small orders, for in the main each customer demanded his own particular shape and size of bottle marked with his own lettering. Large orders of one type of bottle were few and far between and even in the United States, where the general demand for bottles was much greater than in this country, the semi automatic machine, when it proved more economical to employ it, held its own alongside the fully automatic Owens machine for many years. In 1916, for example, in the United States when 190 Owens bottle machines were operating, as many as 290 semi automatic machines were producing bottles at the same time and with just as much satisfaction to the customer.

No doubt such considerations as these persuaded Forster & Sons to continue with their semi automatic machine production begun so successfully at Atlas Street and to find ways and means of expanding it.

The end of the war in 1918 saw bottle production in good trim and the whole factory ready for the next development in the history of the firm – the introduction of fully automatic machines.

During the war great strides had been made in the United States in the development of automatic machines to rival the Owens machine. One of the earliest of these rivals was the O'Neill machine first patented in 1916, and this was quickly followed by the Lynch machine which had its first commercial operation in 1917.

In England, and also in the Continent, all such developments had been impossible during the war, The production of common bottles and the like had ranked low in the scale of priorities in the war effort of the nation, and most of the engineering development and skilled labour had been allocated to the manufacture of munitions and other high priority requirements.

In the United States on the other hand steady advances in manufacturing techniques and in the development of fully automatic bottle machines had been possible all through the war and the coming of fully automatic production methods had provided the answers to the problems of demand. It was essential therefore, if time were to be saved and manufacture brought up to date, that European manufacturers should adopt the new American techniques.

Forster's had been amongst the first in this country to appreciate these new trends in glass container production. They also became aware as trade expanded that bottles for beer, wine and spirits, previously only available in dark green glass, were being demanded in amber glass and to a lesser extent in white flint glass while mineral water bottles and certain other container types, previously made in pale green glass, were being asked for in white flint.

John Forster had always taken a lively interest in all developments in the U.S.A., and quickly realised that the newest automatic machines and glass feeding devices, which were competing successfully with the Owens machine, were more suitable for the manufacture of containers in Britain. These newer types of automatic machines and ancillary equipment were less complicated and less expensive than the Owens machine with its suction technique, and in John Forster's opinion were better able to cater for the diversity of small orders characteristic at that time of British glass container demand.

So it was, before the end of the war, that Forster & Sons decided that when facilities became available they would expand production to match the demand and install fully automatic machines of the O'Neill and Lynch types. Consequently, looking to the future and anticipating the installation of these new machines, Forster's undertook during 1916–17 the construction at Pocket Nook of three additional furnaces (Nos. 5, 6 and 7) and other requisite plant, and early in 1919 it was decided to proceed with the construction of a further furnace – No. 8.

CHAPTER 6

Development at Pocket Nook 1919–1928

Early in 1919, within a few months of the war ending, in order to obtain new capital, not only to finance the installation of automatic machines of the O'Neill and Lynch types, but also for the development and modernisation of the factory that had been planned, Forster & Sons Ltd. was converted into a Public Company and registered on 15th July 1919 under the style of Forster's Glass Co. Ltd. with its registered office in Atlas Street, St. Helens.

Amongst the first activities of the new Company was the purchase of the remaining land and buildings of the old Union Plate Glass Works at Pocket Nook which they did not already own. This meant that the whole site of over 16 acres was available for glass container manufacture. During the war the newly acquired area had been occupied by the Ministry of Munitions which had used it chiefly as a storage depot for munitions.

During 1916 and 1917, three additional furnaces had been constructed and immediately after the end of the war in 1918 the construction of a fourth new furnace was put in hand. Additional annealing lehrs had to be installed and it was decided to use the latest type of producer gas fired open type lehrs with endless slat conveyor belts. For some years after 1919, the first three furnaces at Pocket Nook kept their older pan type annealing lehrs but these also in process of time were replaced by the slat type lehrs.

Of these four new furnaces two had been planned for the melting of amber and two for the melting of white flint. The melting of dark green glass continued on the three older tanks at Pocket Nook because for the time being dark green bottles – at all events as far as weight of glass melted was concerned – remained in greater demand than either white flint or amber glass.

The new furnaces (i.e. Nos. 5, 6, 7 and 8) and lehrs were fired by a battery of Morgan automatic gas producers installed in 1920 by the International Construction Company. For a period the three older furnaces at Pocket Nook and their lehrs continued to be fired from manually operated gas producers of the Siemens type. In the late 1920's, the oldest of these furnaces was fitted with a Chapman gas producer and the other two furnaces were coupled up to the four Morgan producers.

The position now was that the Company formed in 1919 had at its disposal seven furnaces at Pocket Nook with which to carry out the development of automatic production of glass containers by the installation of O'Neill and Lynch machines.

These machines usually carried six finishing moulds although machines with four or with eight moulds were on the market. Forster's indeed worked an eight mould machine for many years, but did not find it as suitable for their type of manufacture as the six mould machine. This six mould O'Neill machine quickly became the standard type of machine at Pocket Nook and as many as fifteen machines had been installed by the late 1920's.

The boiler plant had been extended during 1916–1920 to provide the extra steam required for the Morgan producers and the installation of automatic machines greatly increased the need for compressed air for driving these machines; consequently the power house and compressor plant were enlarged. Some 1,200 H.P. was provided in the compressor house for the large motor driven compressors.

In addition to the air provided by the compressors for the working of the automatic machines, a considerable amount of low pressure air was needed for cooling the side walls of the furnaces and for cooling the moulds at the machines. This was provided by the installation in each tank house, starting in 1916, of large motor driven fans supplying an elaborate system of cooling pipes.

Another feature of the modernisation which took place at Pocket Nook in 1918 was the installation by the Herbert Morris Company of the Telfer overhead transport system for conveying raw batch materials from the mixing rooms to the various furnaces. Three electrically operated travelling cranes, each carrying an iron skip containing about half a ton of mixed batch, ran along overhead rails, the skips being emptied by the crane operator on to the storage area on the furnace floor at the melting end of each furnace.

Even after fully automatic machines were installed, a certain amount of semi automatic production took place on some of the tanks alongside the automatic machines, but this was chiefly to deal with orders for small quantities of special bottles. The furnace at Atlas Street also continued to work with semi automatic Forster machines until 1921 when it was finally shut down and all bottle production centred at Pocket Nook.

Automatic production demanded a very high degree of accuracy both in the temperature and in the consistency of the molten glass when it was delivered to the moulds on the machine via the forehearth and feeding equipment.

Feeders supplying glass to machines by extrusion through an orifice ring were known as "gravity" or "drop" feeders to distinguish them from the suction type of feeder used with Owens machines. During the 1914/18 war years and in the early 1920's several types of these gravity feeders were developed chiefly in the U.S.A. and after considerable experiment Forster's used three different types of drop feeders to supply glass to their automatic machines.

In 1920 a Miller feeder, using a rotating plunger to extrude the "gob" of molten glass, was installed to feed a Miller automatic machine. About the same time and during 1921 several Rankin "drop" feeders were attached to all the tanks at Pocket Nook and were used to feed Lynch and O'Neill automatic machines.

The Rankin feeder was entirely developed and constructed in England and was found by Forster's to be extremely successful in operation. The Miller feeder referred to above was soon replaced by a Rankin Feeder, but in 1922/23 Forster's Glass experimented with a third kind of feeder to supplement the Rankin. This was the Hartford Fairmont paddle feeder and three of these feeders were tried out, one on each colour of glass. These three paddle feeders continued to work for a few years after 1925, but were eventually replaced by the much less complicated Rankin feeders. It is not known whether John Forster's decision was swayed by another advantage that the Rankin had over the Hartford paddle feeder namely, that no royalties were payable.

By the end of 1925 the Rankin feeder had become the standard feeder round the Forster works, some 27 being available on the seven tanks. In 1926 the efficiency and usefulness of these feeders were further enhanced by fitting them with a revolving refractory sleeve.

Although all this plant modernisation and extension was taking place at Pocket Nook, the main engineering and mould making shops, pattern shop, foundry and main engineering stores, all remained at Atlas Street, as did the general offices. Managerial supervision of the whole factory – which had now grown to over 21 acres in extent – also continued from Atlas Street. Before the 1914/18 war, ancillary engineering facilities had been provided at Pocket Nook, where a fitting shop, smithy, engineering shop, mould store and a mould cleaning shop had been established, and these departments were extended as required.

Warehousing and transport facilities were improved by the acquisition of the Pocket Nook site, which contained two very large warehouses with railway lines running alongside and through them. These warehouses soon became a very valuable feature in the despatch of ware to customers, particularly as they allowed the undercover storage and undercover loading of ware directly into railway vans and trucks.

The expansion in production after 1918 resulted in increased traffic of railway wagons carrying raw materials and fuel into the factory, and correspondingly an increase in the railway vans used for the despatch of finished ware. Increased shunting facilities were provided by the purchase of two shunting locomotives of the saddleback tank type to replace the old outworn shunting engine employed at that time.

These two engines – named "Atlas" and "Baghdad" respectively – were powerful examples of their type and quite capable when shunting of dealing with a train-load of ten to fifteen wagons loaded with raw materials or coal. For well over thirty years they gave stalwart service to Forster's Glass and were still being employed at Pocket Nook after the 1939/45 war.

The old tank engine they replaced became a figure of fun in the last years of the war, being long past its old effectiveness but impossible to replace because of war-time limitations. "Phyllis" by name, this engine had all the vagaries of the weaker sex and, coaxed by a vituperative driver, it wheezed its way round the works at Pocket Nook oozing steam at every joint. Because of its leaking tubes and joints, oatmeal was introduced into the boiler water to "fill up the holes", and at the end of its life it was hard pushed to move more than one loaded wagon at a time. Legend has it that at that time if "Phyllis" whistled to warn a trespassing mortal in her

way, she had to stop in order to raise steam again.

A feature of this period was the formation of the Glass Manufacturers' Federation in 1926 which was formed to deal with all matters affecting the status and welfare of the Industry apart from the purely scientific and technical problems dealt with by the Society of Glass Technology. The Federation's objectives included propaganda to increase the use of glass ware by the general public, matters of design and standardisation, and keeping in touch with all Parliamentary matters having a bearing on the interests of its members.

The Federation was well received and Forster's Glass was amongst its founder members. Sir Sydney Henn, soon to be appointed Chairman of Forster's Glass, became the first President of the Federation serving from 1926 to 1929. A further honour granted to Sir Sydney was his appointment as the Chairman of the first convention of the Glass Industry held in 1928.

Trading conditions throughout this period were extremely difficult. The boom which prevailed after the 1914—18 war was only of short duration, and in the early months of 1921 there was a nation-wide collapse in trade, an event remarkable for its suddenness and severity. The impact on the Company was to bring business virtually to a standstill for about four weeks and the tanks were kept more or less just "ticking over". The position was rendered even more difficult by a coal strike which went on for six weeks.

The "Slump", coming so soon after the formation as a Public Company, had a serious effect on the Company's finances. For a long time after the slump, it could be said that the Company had to fight for every penny; dividends on the Preference and Ordinary Shares were suspended and fresh finance had to be raised by the creation in 1923 of £200,000 7½% Debenture Stock, which was taken up in the main by Bovril who was at the time the Company's largest Customer.

The hoped for recovery in trade was slow to materialise and conditions remained extremely difficult throughout the early 1920's with recurrent coal strikes and a general strike in 1926. In view of the fact that the Company then relied entirely on coal for melting purposes, the unsettled state of affairs in the coalfields was a matter of grave concern.

Eventually brighter conditions returned bringing more prosperous trading results and by 1928 it was possible to undertake a reconstruction of capital which events had rendered necessary.

Following the Reconstruction, the profits being earned justified the resumption of dividends on the Preference and Ordinary Shares.

CHAPTER 7

Laboratory and Technical Development

The account of the transformation of Forster's works from semi automatic to fully automatic production would not be complete without some reference to the establishment during this period of chemical and physics laboratories for the scientific control of the melting processes and the finished glasses.

In the years before the 1914—18 War, very little scientific control was exercised in glass manufacture and this was particularly true of the common bottle section of the Industry. Raw materials were crude and varied considerably in composition and the mixing of them was done manually. No attempt was made to control proportions by weighing and the sand, lime and salt cake was usually measured in barrowfuls. The finished bottles were often full of defects, but no systematic attempt was ever made to eradicate these by proper attention to melting techniques or to glass compositions.

In 1915 a small department was started in Sheffield University by Professor W.E.S. Turner to study problems in the glass industry, particularly those relating to the chemical and technological sides. In 1916 Professor Turner founded the Society of Glass Technology with members drawn from glass firms all over Great Britain. The prime object of the Society was to provide meeting places up and down the country where persons interested in glass manufacture could

meet and discuss their problems and exchange information regarding the whole scientific and engineering sides of their industry.

John Forster was one of the first in the glass container industry to realise the great advantages to be gained by a scientific supervision of the glass melting processes and amongst the very earliest members of the Society of Glass Technology were Forster & Sons Limited.

Before the end of 1918 well equipped chemical and physics laboratories had been installed at Pocket Nook complete with a range of testing rooms for the finished bottles and an experimental furnace room. A small laboratory staff had been recruited with a university graduate at its head and with a number of capable assistants. Thus it was that when Forster's Glass was formed in 1919 to undertake their fully automatic (in these days) manufacture of glass bottles, a well equipped department was in being to ensure scientific control of all the manufacturing processes.

The change-over from semi automatic machine production to manufacture on fully automatic machines meant a considerable change in the composition of the glasses melted and scientific direction and supervision of this change was imperative. These composition changes were supervised in the laboratory and the laboratory staff had charge of the batch mixing department. As well as carrying out regular analysis of the various glasses in production, they made day to day checks upon all raw materials and fuel coming into the factory.

The laboratory staff carried out continuous day and night checks upon the temperatures of the furnaces, forehearths and lehrs, by means of optical and static pyrometers, thus providing the tank attendants with information to enable them to execise proper supervision of the melting and annealing processes.

The department also carried out another very important function, the testing of the quality of the production at regular intervals throughout the twenty-four hours. Samples were taken from each lehr and subjected to various quality control tests such as thermal shock, hydraulic pressure, capacity and capping.

In 1925 it was felt that a greater effort was necessary to utilise more effectively in the factory the steadily increasing amount of scientific and technical knowledge rapidly becoming available. To this end it was decided to strengthen the technical and laboratory department by the appointment of Dr. C.J. Peddle as technical manager. He had rendered important national service during and following the 1914–18 war by his contribution to the development of vitally needed scientific and optical glasses, work which was acknowledged by the award of an M.B.E. He had also been closely associated with the founding of the Society of Glass Technology of which he was later elected President.

Dr. Peddle brought to his new task as technical manager of Forster's Glass a very special knowledge of the relationships between the compositions and properties of glasses, also of the practical processes and problems of glass manufacture and his influence was quickly felt.

CHAPTER 8

Before, During and After the 1939–45 War

Following the death of John Forster in 1927 the two sons, Willom and Walter Forster, took over the management of the Company. They continued the same excellent pattern of relationship between the management and the employees established earlier by their father.

After the reconstruction of capital in 1928, better trading conditions led to some years of steady progress during which the main developments were increases in furnace lives, the speeding up of existing bottle machines and the installation and development of new types, particularly the Mitchell press and blow machine for the manufacture of wide mouth ware. Attention was also given to the packing and storage of ware and valuable work was done on the development of the process for applied colour enamelled labels. The outbreak of war in 1939 imposed a handicap to the further development and expansion of the Company because of the large number of employees called up for military service. This handicap was offset to an extent by the employ-

ment of women for the less skilled and arduous occupations such as taking-in (i.e. the conveyance of bottles from the machines to the lehrs) and warehouse work. By this means three-shift production was maintained throughout the war years.

To set against the initial restrictions on the glass producing side of the factory, there came once again a call to produce munitions. With a well equipped engineering section at Atlas Street, it was possible to turn over to the manufacture of war material in large amounts, and so efficiently was this done that larger contracts were obtained which called for the erection of additional engineering buildings. Demands for glass output also increased so that the numbers employed by the Company increased to over 2,200 employees.

So successful was the war work undertaken that when peace was once more restored the directors were proud to publish a booklet outlining the contribution of the Company to the war effort. This booklet is included as Appendix III.

The incidence of war conditions resulted in some difficulties in obtaining raw materials, mainly for colourless glass. Much of the pure sand had been imported from Belgium, a source of supply which was very quickly cut off. To a large degree the loss was overcome by the introduction of an extremely pure sand, the quarrying of which was commenced at Loch Aline on the west coast of Scotland. Due to its very high cost, the new sand was diluted with local, less pure, sands. A second failure was that of the element selenium, essential for removing the last traces of colour in the glass, but entirely appropriated for war purposes. Because of these two shortages the glass in time became of a slight green colour, so remaining until peace returned.

An account of wartime activities would be incomplete without some mention of the efficient anti air-raid precautions put into effect by the management and maintained continuously through the period of danger. Blackout conditions had to be created for the hours of darkness, a condition difficult, if not impossible, in a works including several furnaces and also with well-lit buildings, to and from which movement was continuous by night and day. Air-raid shelters were constructed, so situated that all employees could reach safety very quickly when warned – a necessary precaution.

A control centre was established in the works, manned, through the hours of darkness, in rotation, by two members of the senior staff. This control centre was in constant communication by 'phone with the central control at Pilkingtons which was in touch with a ring of listening posts around the town and also with the Observer Corps., who supplied a continuous report of enemy aircraft movements during raid periods. It was the difficult task of works control to keep production as continuous as possible on raid nights, but to sound the "take cover" klaxons whenever there was a risk to the safety of the men at work. Fortunately, though a number of bombs and incendiaries fell in close proximity, the works escaped without casualties or damage.

The end of the war in 1945 saw a run down of work on munitions and a gradual changeover to normal working conditions. Up to that time continuous production had been achieved by means of an eight hour three-shift system which inevitably brought about a sixteen hour production stop each fortnight, comprising the last shift of one week and the first of the following week. This allowed the necessary rotation of shift personnel to take in turn the 6–2, 2–10 and 10–6 shifts in successive periods, and secondly provided the down time required for the opening-up of flues carrying the hot gases to allow the removal of the soot which gradually collected in them during working periods. The consequent loss of production was not confined to the stop turns, but included that in the time needed to restart and to get the machines back to full production efficiency.

In 1946 a scheme was put into operation to eliminate these machine time losses. Continuity of production was secured over the burn-out period by the use of oil burners inserted into the tanks along the sides of the melting end, the waste gases being short circuited to the chimney flue. The four-set system, with regular rotation of shifts, was introduced initially in the production and sorting departments and ultimately was applied more or less to all shift working departments.

About this time the first moves were made to draw up tentative plans for further developments in the works and of the Company, and in 1946 it was decided to acquire the "Globe Lands" adjoining the works for future expansion. Post war developments, designed to promote a greater degree of mechanisation and increase all round efficiency, were now commenced in many directions. Amongst these was the replacement of producer gas by fuel oil as

a heating medium for the tanks. Trials were carried out on the No. 9 tank in 1946 soon followed by the installation of a fuel oil system in No. 5 tank during a complete rebuild of that furnace in 1947. With the knowledge gained, oil firing gradually became standard procedure in all tanks and did away with the many difficulties of making and supplying gas from coal in mechanical producers as well as eliminating the need for a great amount of heavy labour.

Further improvements to working conditions in the furnace department resulted from the installation of mechanical batch feeders at each furnace commencing with No. 7 in 1948. Up to that time the job of shovelling glass batch from the platform to the "dog house" of the tank and thence into the molten glass beyond required much "toil and sweat". The excessive heat added to the hard labour making the task particularly arduous.

A third change lay in the steady replacement of the older "Slat" lehrs by lehrs of a more convenient kind, designed and built in the works and fitted with wire mesh belts of the kind used in the Hartford lehrs. They were heated independently of the producers, had effective means of control, and were equipped with automatic stackers which ensured that every bottle reached the lehrs in exactly the same time and condition, allowing maximum uniformity in the annealing process, whilst the need for a large number of semi-skilled takers-in was obviated.

The whole process of manufacture from the point of delivery of the raw batch to the tank to the point of examination of the finished ware by the sorters was not completely mechanised, admitting a much more rigid control in manufacture than before.

There remained the extremes of the process to be modernised. Firstly the weighing, mixing and delivery of the batch; secondly, the handling and movement of the finished ware after inspection. The last named problem was the earliest to receive attention, and for this purpose it was decided in 1950 to seek the advice of a firm of management consultants on possible economies in warehousing, packing and distribution.

Enormous quantities of bottles, amounting to several millions per week, arrived at the end of the lehrs constantly, night and day, and had to be as constantly removed after sorting to prevent a complete snarling up of the whole system. Procedure at the lehr ends was to place the ware in wooden barrows which were wheeled away when full. Taken to the pens in the various warehouses, the bottles were stacked tier upon tier, often to a considerable height. There they remained until a call from the customer demanded unstacking and repacking for delivery. Such treatment inevitably involved liability of breakage, surface scratching and dirt. Delivery was mostly by railway truck when the bottles were either packed in bulk or in wooden boxes.

A first improvement in methods came from the use at the lehr ends of cardboard cartons into which the ware was packed by the sorters and covered as a protection against dirt by newspaper. The packed cartons were then penned and the ware remained clean and removal for delivery made much easier. An obvious further step which was later adopted was the method of moving and stacking of the cartons on wooden pallets, which could be lifted and moved by fork lift trucks. By these means the warehouse losses were much reduced and the appearance of the ware on delivery to customers was greatly improved.

The introduction of these new methods of packing at the lehr end inevitably led to a review of sorters' conditions of work and earnings. This problem was considered closely by the management, who sought the advice of management consultants. From their recommendations, based on a thorough investigation of all aspects of the problem, a sorting incentive scheme was put forward with a system of "workloads". The scheme was accepted and the revised procedure operated for many years.

CHAPTER 9

The Decorating Department

Reference has been made in a previous chapter to the work done by the Company on the development of the process for applying coloured enamel labels to bottles. From simple beginnings in the 1930's, a very successful department had been progressively developed. It stemmed

largely from the desire of milk distributors to advertise by coloured designs on their bottles, ranging from simple display of names to ambitious patterns and scenes. Brewing and other industries have also used the medium but to a much less degree.

The first step taken by the firm was to introduce a process of sand-blasting designs on to the bottles. A further step was to rub into the etched design a coloured cement, which remained in position for a long period of time.

The next step was to use coloured enamels which are finely ground powders consisting of a coloured glass having a lower melting point than the bottle, and an oily binding material. A flat rubber pad bore the desired design in relief, and this was given a coat of enamel by a rubber roller. The design was transferred to the bottle surface by rolling the bottle over the pad and the decorated ware was then passed through a lehr thus fusing the enamel into the glass of the bottle. With so crude a process results were of very moderate quality. The first enamelling lehr installed in the works was built in 1929.

A further move forward was to employ a transfer process. The transfer consisted of a porous paper backing to which was attached by means of a gum interlayer a thin transparent film carrying the design printed in glass enamel. In order to decorate the ware the transfer was soaked in water, so dissolving the gum and allowing the cellulose layer to be slid on to the bottle which then went through the firing process as before. Results were of good quality with fine detail and could consist of several colours in one process, but the transfers were costly and the process of transferring required considerable dexterity and was slow to operate. These factors caused a substantial increase to the cost of the bottles, but many customers felt the expense was justified. All designs for both processes were developed in the works by a skilled artist.

The next step to improve the speed and reduce the cost of production was by introducing the silk screen method. The fine mesh of the silk screen, being impregnated with a thin layer of poly-vinyl material, was converted into a stencil of the required design by a photo-chemical process carried out in the department. The use of the screen and frame on semi automatic machines gave results of quite good quality at speeds greatly in excess of those obtained in the transfer process. Whilst only one colour of enamel could be applied at any one time, it was possible with one or more subsequent treatments to obtain multi coloured results.

The department expanded and in order to cope with the output from a number of semi automatic machines, a large capacity lehr with accurate speed and temperature controls was installed.

After the end of the second world war, considerable attention was given to extending the use of decorated bottles, particularly in the mineral water industry.

Such a demand required the production of single colour and multi-coloured designs on mineral water bottles at increased speeds, and at a competitive price. This called for fully automatic operation, and the development of fully automatic machines. Before the practical application of such machines was possible, a most important and preliminary problem had to be overcome rather than met.

In previous years coloured enamels had been printed by the screening process in the form of "cold" paint. This later consisted of the ground coloured enamel mixed into liquid media, consisting of such basic constituents as pine oil, cellulosic solutions, etc. Such enamel paint resembles ordinary paint in appearance and indeed in physical property that a drying period, forced or otherwise, was necessary before a further print could be applied.

The development of fully automatic printing obviously called for an enamel paint which would allow one colour to follow another in multi colour designs, without the time and space wasting necessity of drying between prints.

The outcome of the production was thermoplastic enamels. These are essentially made up of enamel, hot mixed and milled into organic materials, such as waxes. These colours on cooling set, and are broken into small lumps, and it is in this form that the decorator received this material.

Sometime was to elapse before these materials were entirely reliable and satisfactory. However the thermoplastics opened the way for the use of fully automatic screen printing machines. These were capable of applying different colours in rapid succession. In the main three colours was the maximum number normally applied.

With faster printing speeds, the more severe ware conditions, and the application of heat to

render the thermoplastic enamels fluid, it was necessary to replace the original silk screen by one made of fine stainless steel mesh.

Certain characteristics of the original thermoplastic media were most unsatisfactory, causing the colour to run and the enamel to underfire. The latter lost the essential appeal of the decoration, namely brightness and gloss.

This investigation into the elimination of these faults was promoted by the department. With the assistance of a leading colour manufacturer, a thermoplastic medium was produced which gave back to the colours their essential brightness and gloss. Apart from the improved appearance of the finished product, the workability and stability of the new thermoplastic colours were improved beyond recognition and these particular media are still used at the present time.

This led to a much higher standard of quality in the printing of the various designs and this quality was recognised not only in the home market but also in those world markets to which the Company's bottles were exported.

CHAPTER 10

Plant and Technical Advances 1920–1966

Major improvements are generally achieved, not by a single break through, but by a series of steps through the years, often in close collaboration with outside suppliers of plant. This was true in many cases of advance by the Company, such as increasing the efficiency of tank furnaces, machines, lehrs and enamelling processes.

Furnaces

An important factor affecting the efficiency of the tanks was the length of life which could be obtained before closing down and repair was necessary. It was largely governed by the rate of attack by the molten glass on the fireclay blocks forming the walls and throat of the furnace. This was much heavier in the case of colourless glass, through which heat penetrated to a greater degree than through the amber and green glasses. Whereas in the latter case erosion was limited in general to a region near the surface of the glass, in the former, blocks were attacked to a depth of several feet below the surface, and particularly along the block joints. The working life of colourless glass tanks in earlier years had been only some six or eight months, as against periods of up to two years sometimes obtained for coloured glass.

In order to reduce this wear, air or water cooling of outer face of the blocks was necessary But the general quality of tank blocks as supplied was uneven, so that one or more of the blocks would often, by more rapid disintegration, cause trouble at an early date.

Tank block manufacturers were acutely aware of the unsatisfactory nature of their products, some carrying out exhaustive experiments to create a more reliable product. By working in close liaison with certain of these, Forster's succeeded through the years in securing fireclay blocks of steadily improving quality.

A spectacular advance was made by the introduction of "Corhart" blocks, the result of researches begun in the United States in 1923. These refractories were made from a mixture of silica sand and alumina in suitable proportions, which on melting in an electric furnace at a temperature of 2000°C, then pouring into a mould and cooling carefully, gave blocks which were entirely a mass of interlacing mullite crystals most resistant to glass attack. This material was very costly.

With such a range of high quality blocks it was now possible to build furnaces having a greatly increased life, colourless glass tanks with a life of two years or more becoming the norm. To attain this improvement at a reasonable cost the higher priced blocks were employed in the most vulnerable points only. At first Corhart blocks were in short supply, only five tanks in this country being constructed with them in 1933, but with the building of a works for their manufacture in the French Alps, where cheap electric power for melting was available, they were read-

ily obtained by 1937. Forster's was one of the earliest firms to use the improved refractories, and later a further material giving high resistance to glass attack, namely zirconia, was also added to the list of materials used.

An important point of furnace deterioration was in regenerator chambers where firebrick checkerwork was gradually clogged by the action of hot gas and alkali dust from the combustion chamber. The use of modern types of refractory brick had made great improvement in regenerator life.

The thermal efficiency of the early furnaces was not particularly good, little more than 10% of the potential heat from the coal being available for the useful work of melting the batch and refining the glass. Much of the heat produced passed up the chimney with the hot waste gas, although the adoption of regenerators had made a significant improvement in the conservation of heat. Further improvement of efficiency with a consequent saving of fuel was a field promising important savings in cost of production, and the problem has been tackled from several directions through the years.

One of the first moves was taken in the first building of No. 9 tank, where regenerators of substantially larger size were introduced, so retaining a larger proportion of the heat from the exit gases. Visitors who saw this change were very impressed by what was then a novelty in a glass works. But it was then only a beginning: since that time regenerator size has further substantially increased.

Then also the change from coal to oil firing has brought savings, not only in better furnace control, but also from the fact that over 10% of the heat derived from the coal was not available in the tank, being used for making the gas in the producer before it passed into the furnace. In addition, gas regenerators were dispensed with, more room therefore being available for enlargement of the air regenerators.

The introduction of batch chargers gave a further increase of furnace efficiency from the fact that a thin layer of batch trickling on to the surface of the molten glass was much more rapidly and effectively melted than a large batch pile reaching, like an iceberg, into the lower and cooler layers of the glass.

A large proportion of heat supplied to the furnace is lost by conduction through the walls into the air around and the ground below. This is probably 60–70% of the total heat input. Consideration of the problem led to the introduction of insulation wherever possible in order to retain as much of the heat as possible. This was generally done by the application of an outer layer of insulating brick to the outer face of refractory blocks or bricks. It was most effective when applied to the crown of the tank, which is the greatest culprit, but its use on port stacks, regenerators and flues was also found useful. Insulation has its dangers, since the protected refractory becomes hotter throughout, and only when bricks and blocks of the highest quality were available was the risk of collapse overcome. The spectacular collapse of the hot tank crown in the earlier days illustrated the difficulties of the problem.

With improvement in thermal efficiency it was possible to obtain much larger outputs of glass of good quality from a tank without increasing its size, a necessity enforced by the increased rates of production of the newer machines. A tank which was built to serve six or seven machines in the old days will now, using only four machines, give an output rate of glass twice as great as was formerly the case.

Feeders

The Rankin feeder developed in 1921, and built with refractory parts, sleeves, rings and plungers made in the works pot room, proved for more than 30 years to be adequate for its purpose, but increasing demands for improvement of glass distribution in the ware and more stringent dimension and weight tolerances which could be obtained by the introduction of newer machines then found it wanting. In recent years it has been replaced by the modern Hartford feeder. This has a much longer channel leading from tank to feeder ring, and is conditioned by a carefully controlled system of town gas burners. The gob is cut off by a more robust and accurate shear unit. By such means a gob more accurate in weight, shape and temperature distribution is supplied to the machine than was previously the case. Adequate instrumentation and controls are available for the use of the machine attendant. The result has been to allow the quality of the drop-fed machine bottle to equal that of the suction machine bottle.

Machines

It has been noted that when the Works was converted to automatic production two makes of machine were purchased, the American O'Neill and Lynch. Both were two table, intermittent rotation, gob-fed machines. With the passage of time the Lynch machines were discarded. Since moulds were not interchangeable on the two types of machine, the use of one make alone allowed a reduction in the number of moulds it was necessary to store. There followed a close liaison with the O'Neill Machine Company for purposes of maintenance and development. In the early 1930's this firm was very active in research, and two of their innovations were soon added to Forster's list. The 50 machine, and two-table feeder operated machine was novel in that its tables were in constant rotation, allowing increased speeds of production. Ingenious devices were incorporated in this machine to ensure that the falling gob of glass fell accurately into the steadily moving parison below, and to transfer the finished ware from machine to conveyor belt. Several machines of this type were purchased and have given good service over the years. The 96 machine was a suction machine, again of the two-table constant rotation type, designed to obtain the good qualities of Owens machine ware, such as very good distribution of glass in the ware with accurate capacities. In the 96 machine the charge of molten glass is collected by the parison mould by suction from a special open feeder projecting from the working end of the tank, as the mould in its rotation sweeps over the surface of the glass. Two of these machines were purchased in 1936–7 and used on No. 9 tank for the production of milk bottles. But the speed of the machines was not great enough for them to compete with feeder-fed machines, especially as the quality of the ware from the latter was steadily improving. After several years of trial, use of the 96 machines was discontinued.

In 1937 the reliance on O'Neill machines was relaxed when the Company arranged for W.B. Mitchell to build an English machine for special work. This was a single-table constant rotation machine, with both parison and finishing moulds on the one table. Shaping of the parison was by plunger pressure alone, so limiting production to wide mouth ware. Quality and production rate were good for such ware as jam and paste jars.

In recent years there have been striking improvements in Lynch machines, both in the speed and quality of ware which they produce. Their performance has so outstripped that of the O'Neill machines that in 1955, as the first step in a new modernisation programme it was decided to purchase a number of these machines. One novel feature exploited in the Lynch machine has been the use of double parison and blow moulds, each unit being supplied simultaneously by two gobs, and producing two bottles. This has led to a big increase in productivity. At present the Company has several of these modern Lynch machines, and as a result of improved production, increased profits have been sufficient to finance a still further advance.

The final objective has been to introduce the I.S. (Individual Section) machine invented in 1925 by H.W. Ingle and G. Smith of the Hartford Fairmont Company. In this machine the finishing moulds are arranged in a straight line along the front edge of the machine, being located alongside a conveyor for removing the finished ware. A row of parison moulds, one facing each finishing mould, stands behind, each served by a chute which conveys the gob to its parison moulds, these being served with glass in a certain order. Parison moulds are inverted with the ring below, and as the gob drops in the mould is sealed above by a baffle, the parison then being blown up from below. The parison mould opens and the glass held by the ring, which is attached to an arm, is swung through 180° to hang in the finishing mould which closes for the bottle to be blown. Finally the mould opens and the ware is pushed on to the conveyor. Each blow and parison mould constitutes a single complete machine (or individual section) and as each parison is blown to shape the previously delivered one is at the same time being blown in the finishing mould. The rate of production is thus much greater than that of the older machines with the same number of units. Earlier machines had four units but six section machines are now standard. I.S. machines which were first purchased in 1958 gradually replaced the O'Neill, Mitchell and Lynch machines.

Lehrs

Modernisation of the lehrs, though desirable, presented a problem. It had been partially done in the colourless glass tanks, entirely so in No.9 tank, by oil fired Hartford lehrs, having a wire mesh belt. But such lehrs were very expensive to install, and since each machine needed

its own lehr, which was out of operation for long periods during tank rebuilding, a complete change-over represented a high capital cost.

As an alternative it was decided to design and build in the Works much less expensive lehrs provided with mesh belts but heated by electricity. This was successfully done and in the process the Works Electrical sub-station was completely modernised. Eventually, though the new lehrs performed annealing quite successully, costing showed that electricity was too expensive a heating medium.

Accordingly, the lehrs were redesigned to be fired by town gas which proved a much more economical proposition. In recent years a still more efficient town gas fired lehr has replaced the older form. In it the belt carrying the hot glass rests on a set of steel rollers, under which the return section of the belt passes on its passage to the front of the lehr, and is preheated by the hot ware above. It has been possible to circulate the products of combustion within the lehr to obtain correct temperature conditions, without danger of sulphur blooming the ware.

CHAPTER 11

Welfare and Social Developments

The glass bottle industry in its early years was one involving much hot and arduous labour, whilst there was no marked effort by employers, in general, to improve working conditions to any great extent. With the growth of mechanisation there arose a greater realisation of the need for welfare work, this being led, in general, by the larger and more progressive firms.

In a firm founded by one with so fine a record of public service as Mr. John Forster, it is not surprising that the welfare and comfort of the men should receive careful attention. The steady growth of the Company was marked by an equally steady development of its welfare work.

An early problem was that of meals for employees, which in a works involving continuous machine production presented some difficulty. It was solved by the provision of a canteen, within the works and easily accessible, open day and night, for the supply of hot meals and snacks as desired. The original building, though somewhat rough, was well managed and clean. It was well supported, serving for many years until replaced in the late 1950's by an improved building and a widened service.

Medical inspection and care also received due attention. In addition to the general supervision of health matters by a local doctor, a works clinic was established under the charge of a nursing sister, with a staff which allowed of the presence of a trained nurse at all times, day or night.

As opportunity presented itself, the firm developed a widening interest in the social and recreational life of its workpeople in their leisure time. In 1921 a qualified Social and Welfare Officer, Mr. H. Barlow, was appointed to take charge of this work, proving very active in promoting both physical and intellectual pursuits for all desiring to take part therein. One such activity was the provision of a football ground, where the younger employees were encouraged to play "soccer", teams being entered in a local works league. This was continued by Mr. Barlow's successors, until in more recent years the retention of a ground suitably situated for the convenience of the players was not found available, and this activity lapsed.

Social work was helped appreciably by the provision by the Directors in 1930 of a handsome club house, situated close to the works. It was designed with a comfortable and spacious hall, suitable for meetings, concerts, recreation and special celebrations involving meals, etc. A wing of this building housed three full sized billiard tables, and this section could be screened off if necessary. Space was also reserved for further expansion if and when it was needed.

By this useful provision, recreational activities were greatly extended. The billiard tables were regularly in use, the teams enrolled in local billiards and snooker leagues.

On the educational side, the club allowed the formation of a dramatic section, and a regular production of plays was commenced with casts recruited from both the works and office staffs.

This development was made possible by the construction of a temporary stage, set up at the end of the hall when needed. Mr. Barlow proved adept in the design and provision of scenery, whilst play production was undertaken for several years by Dr. A. Cousen, followed by Dr. C.L. Moore. In spite of the difficulties of mounting the plays and accommodating the large and appreciative audiences, the dramatic section was very successful over the years and gave much pleasure to employees and their families.

Throughout the years the Directors have been mindful of those workers who have faithfully served the firm until they have reached the age of retirement. With the passage of the years the number of these has distinctly increased. They have been remembered in two ways. First, as the Company has prospered it has been able to establish Pension Schemes giving them retirement benefits which were additional to the state pension. Secondly there has been the organisation through the Social and Welfare Officer of a dinner and subsequent concert to herald in the Christmas season; also in the summer of a day's visit by coach to bright and breezy Blackpool.

In the past twenty five years or so there has been an increasing desire on the part of all employees to know more of the activities of the Company which directly affect them and, where possible, to exert influence in such matters.

Even in the early stages the Directors realised the reasonableness of such an attitude and decided on the formation of a Works Council. This consisted of a democratically elected group of the employees together with a number of members of the staff most likely to be concerned, meeting monthly under the chairmanship of the Works Manager. Its scope was to discuss and advise on any points in which the employees were directly involved, in order to prevent misunderstanding or dissatisfaction, so oiling the wheels, as it were, to ensure that no major causes of trouble should arise. Through the years the Council has done much to create a feeling of goodwill throughout the works.

One interesting feature sponsored by the Works Council has been the suggestion box. Through it a number of useful improvements in the running of the works have been suggested and adopted, with suitable awards for their authors. On the other hand, some of the proposals have not been very practicable, and one who was concerned remembers, for instance, the Works Engineer spending many hours in a vain endeavour to convince a would be inventor that his suggestion for a conveyor of bottles from the suction machine to the lehr with subsequent stacking of these was quite impossible to carry out.

In the matter of the training of employees the Management has always been helpful and sympathetic. In addition to the training of apprentices (a routine procedure) several young men have been encouraged to undertake a three year sandwich course at the St. Helens Technical College Department of Glass Technology, resulting in the granting of a Diploma. The same Department has sponsored a number of short courses for foremen in which many employees from Forster's have received useful instruction.

Finally, within the firm itself, in recent years the Technical Department has arranged many lectures in order to help the men to understand the basic principles of glass manufacture and the correct use of instruments and devices used by them in controlling the operations which they are carrying out.

CHAPTER 12

Development in the Last Decade

Two appointments were made in the 1950's which as it turned out were to herald a new era for the Company – these were the appointments in 1952 of Mr. W.O. Hinds as works manager, and in 1954 of Mr. E.G. Turner, F.C.A., to the Board of Directors as financial adviser.

Mr. Hinds joined the Company at a time when the country was experiencing another period of recession which was reflected at the works by a decrease in the level of production. At such a time renewed efforts were called for to increase the all round efficiency of operation and to meet the increasing competition. His team of departmental managers quickly responded to the

example set by his leadership and enthusiasm, and faced up to the challenge with determination.

It soon became clear that despite all efforts the limits of progress, under existing conditions and with the existing plant, had been reached. In order to remain in the forefront of the industry, considerable modernisation of the works was necessary. Accordingly the master plan, originally drawn up in outline during the immediate post war years, was updated and modern improvements incorporated.

This revised master plan for the modernisation and expansion of the works was submitted to the Board of Directors who recognised that the proposals, which called for substantial capital investment, were necessary for ultimate economic survival. It was therefore decided to proceed and Mr. E.G. Turner negotiated satisfactory arrangements with the Company's bankers for the necessary financial facilities. In October 1954, work on the initial five schemes was put in hand and so, admirably led by Mr. Hinds and under the overall guidance of Mr. Turner who was Chairman of the local Committee of Directors, the management team entered into probably the most exciting period in the Company's history since John Forster acquired the Pocket Nook site in 1908 for expansion.

Quite soon signs became evident that the cumulative effect of the change involved in the master plan would bring about greater financial benefits than had originally been forecast. With the growing importance of his work and responsibilities, as well as recognising his effective leadership in the works, Mr. Hinds was appointed a Director in 1954.

During the nine years 1955–1963 the capital employed was well nigh trebled by capital expenditure amounting to some £2,000,000. In addition upwards of £500,000 was spent on a planned programme of furnace development on rebuilds during 1957/59. One of the largest projects in this area of expenditure was the complete rebuild of No. 9 furnace on the area previously occupied by the gas producers, and the site previously occupied by No. 9 furnace was developed into a modern warehouse.

With the furnace development programme complete the result was that the then larger flint furnaces were in line (Nos. 6, 7 and 9) with back-up warehouse accommodation, and similarly for the amber furnaces.

Large sums were spent on improving roadways and marshalling areas, and over £120,000 was spent on developing and increasing covered warehouse accommodation.

Considerable expenditure was allocated to developing and increasing the covered warehouse accommodation, but the major expenditure was incurred on the following projects:—

Raw Material Handling and Storage
Batch mixing and overhead distribution
Electrical distribution and sub-stations
Further bottle machines of the I.S. type and control equipment
Steam raising plant
New enamelling department
New canteen, etc. etc.

The factory was completely transformed and the level of production was not only maintained but increased during these years of change when almost the whole of the works area had the appearance of a civil engineering site.

In a matter of six years from its inception the main parts of the initial development schemes were substantially complete and the financial benefits, greater than originally envisaged, were such that it was possible to undertake a further programme during 1964–66. The main projects in this latest development scheme were:—

I.S. type bottle machines
New compressor house, compressors and air mains
Further warehouse accommodation
Development of Globe Field area
New Works entrance at Merton Bank
New roadways and improvements to existing road.

CHAPTER 13

Board and Management

When Forster's Glass Co. Ltd. was formed in 1919 it had an issued capital of £350,000 divided equally between Ordinary shares of £1 each and Preference Shares of £1 each.

The first chairman was Alderman John Forster, the founder of the original Forster undertaking. His eldest son, Mr. Walter Forster and his second son Mr. W.A. Forster were appointed Joint Managing Directors. Another member of the Board was Sir Sydney H.H. Henn – destined later to become Chairman of the Company on the death of Alderman John Forster in 1927.

Mr. Walter Forster and Mr. W.A. Forster had grown up with the works and therefore had first hand knowledge of its various activities. In addition Mr. Walter Forster had taken teams of employees to China and South Africa to supervise the construction and initial production of glass container factories of a similar type to the home factory which gave him further valuable experience. A third son, Mr. Arthur C. Forster was appointed to the Board in 1920. He resigned in 1929.

As a result of steady progress the company had built up by the mid-nineteen twenties a well equipped and highly mechanised factory and so possessed the capacity for handling long-term contracts so vital for maintaining regular and continuous production. A notable example of this was the supply of amber jars to Bovril Limited: an initial contract had been secured in August 1922, and a close association of the two Companies was built up, a relationship which was continued to the present time.

Mr. Douglas Walter, a director of Bovril, joined the Board of Forster's Glass Co. Ltd. in 1923, and served until his retirement in 1946, when he was succeeded by Mr. S.P. Dormer, the then Managing Director of Bovril. After his death in 1953 he was succeeded by Lord Luke, the Chairman of Bovril.

In 1926 the Company became closely associated with Watney Combe Reid & Co. Ltd. who owned the United Kingdom Glass Company's factory at Hayes, Middlesex which supplied them with their bottle requirements. An interesting point was,the U.K.G. factory was one which had purchased "Forster" machines.

In 1929, at the invitation of Watney's, Forster's Glass took over the management of the factory for a short period and Mr. C.R. Brooks was transferred from St. Helens to be manager. Later in May 1931 by agreement with Watney's Forster's acquired United Kingdom Glass Company, the purchase price being met by the issue to Watney's of £50,000 Second Debentures. Production having proved uneconomic at Hayes, manufacture there was discontinued and all production concentrated at St. Helens, Forster's Glass becoming the sole supplier to Watneys.

The issue of the Second Debentures to Watneys forged the first financial link between the two Companies, and under terms of the Debentures they were repaid by 1942, part in cash and part by the issue of Ordinary Shares making them the second largest shareholder. In 1931 Major A.C. Bonsor, the Managing Director and latterly Chairman of Watneys, joined the Company's Board and served until his retirement in 1959 when he was succeeded by Mr. J.S.O. Haslewood, M.C., a member of the Watney Board.

The year 1927 was marked by the death of the founder and Chairman, Alderman John Forster. In addition to his active business life during which he had led his company to be recognised as one of the leading glass container manufacturers in the country, he had also served his native town of St. Helens well. Ex-major, Justice of the Peace, he had been a member of the council continuously for over forty-three years. He was succeeded as Chairman by Sir Sydney H.H. Henn, K.B.E., who had been a director of the Company since 1915.

Sir Sydney already had a varied and distinguished career, serving first for thirty years as a business representative in Chile, then on his return to England in 1913, holding some very important positions in government service during the 1914–18 war. He was later a member of Parliament for Blackburn (1922–29), with a strong interest in Imperial and Colonial Affairs, serving on a Parliamentary commission touring Australia in 1927. He was also Chairman of the Joint East African Board. His interest in the Glass Container Industry commenced in 1915 when he was invited by Mr. John Forster to join the Board of Forster and Sons Limited and contin-

ued without abatement until his death in 1936. Sir Sydney's commercial experience proved of invaluable help in guiding the company through some difficult years before and after his appointment as Chairman. He was succeeded by Col. C.E. Ponsonby, T.D., D.L., who held the office as Chairman until his retirement at the end of 1967.

Col. Ponsonby was a director of several companies and served in the 1914–18 war in Gallipoli, Egypt, Palestine and France and was awarded the Croix de Geurre avec Palmes. Conservative member of Parliament for Sevenoaks from 1935–50 he took part in Parliamentary delegations and missions to Russia, Austria, Burma and Nigeria. He was President of the Glass Manufacturers Federation from 1946–53 and was created a Baronet in 1956. He rendered great service to the Company.

In 1945 the Company suffered a grievous loss in the death of Mr. W.A. Forster, Joint Managing Director. He had held office for 26 years and earlier had been a director of the Company for 14 years, before it became public. His service to the Company had been invaluable.

Following the death of Mr. W.A. Forster, Mr. R. Guest (General Manager) and Dr. C.J. Peddle (Technical Director) were appointed Directors. Mr. Guest retired in 1950 and Dr. Peddle in 1952. Later in 1947 Mr. Michael L. Forster B.A., (Son of Mr. W.A. Forster) and Mr. C.S. Harrison (Son-in-law of Mr. Walter Forster) were appointed to the Board.

In 1954 Mr. Walter Forster (Managing Director) died. He had been Joint Managing Director for 26 years, Managing Director since 1945 and for 14 years a Director of the Company before it was made public. Jointly with his brother Mr. W.A. Forster they had guided the Company through many difficult times and much was owed to their wise councels and leadership. In succession to Mr. Walter Forster, Mr. Michael L. Forster, B.A., was appointed Managing Director. He resigned in 1963 for health reasons, and his resignation brought to an end the interest of the Forster family in the day to day management. Other Board changes were the resignation of Mr. C.S. Harrison and the appointment of Mr. E.G. Turner, F.C.A., as financial adviser, Mr. W.J. Smith (London Manager) was also appointed a Director in 1954: he retired in 1965.

In January 1964 Mr. W.O. Hinds was killed in a motor accident whilst on a business trip to Scotland. He had been appointed a Director in 1954 when the success of the development schemes recently started was obviously assured. His promotion had been well earned and he had become sole Managing Director on the resignation of Mr. M.L. Forster in 1963. His knowledge and experience of glass container production was recognised by the industry and he had been invited to join the various trade associations. His untimely death was not only a great loss to the Company but also to the industry as a whole. With his guiding hand so suddenly removed the Board decided to appoint a Management committee consisting of Mr. A.D. Morris (Secretary and Chief Accountant), Mr. A.H. Monaghan (Marketing Manager) and Mr. M.J. Hinds (Works Manager) under the chairmanship of Mr. E.G. Turner who became vice-chairman of the Board. This arrangement worked well for the Company and in May 1966 Mr. A.D. Morris was appointed a Director and subsequently Mr. A.H. Monaghan and Mr. M.J. Hinds were also appointed to the Board.

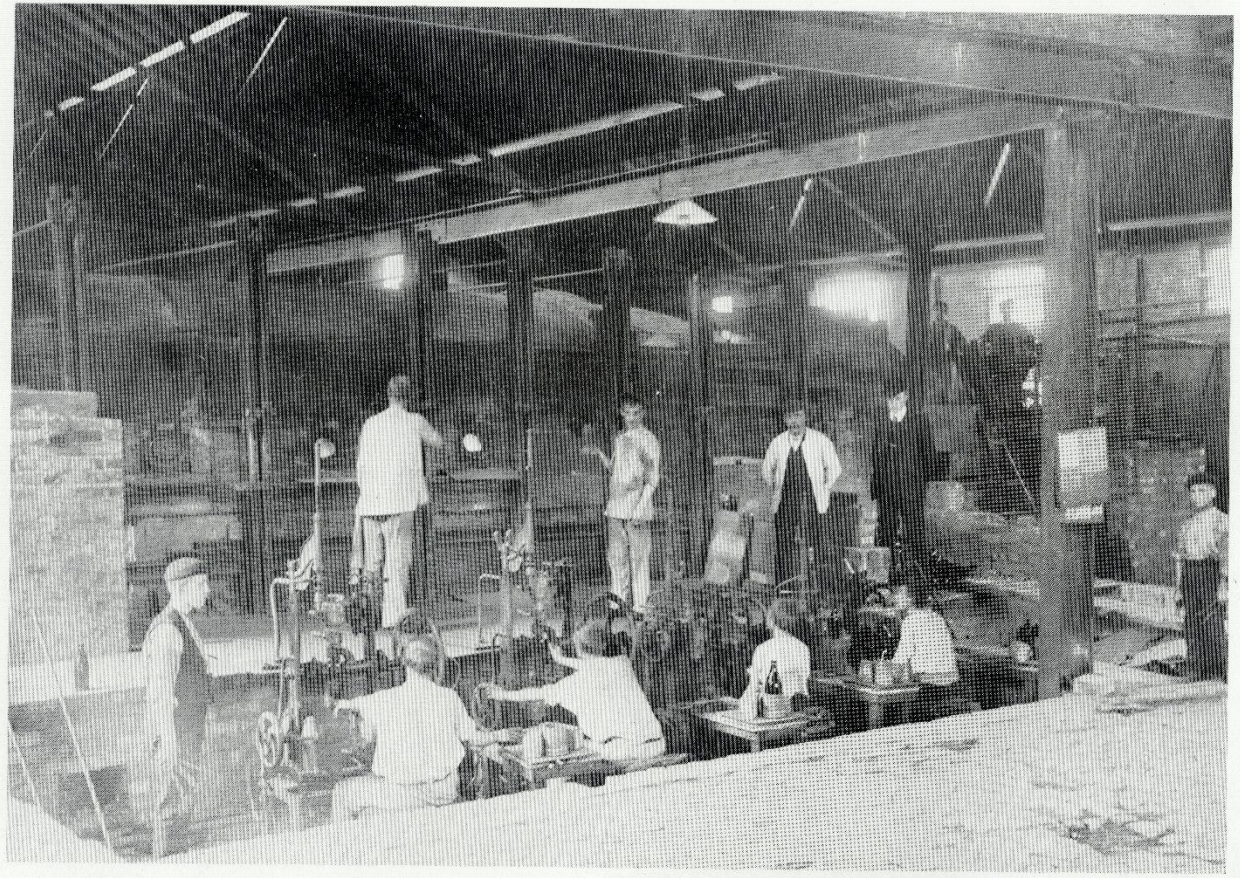
In recent years the Board had considered possible re-grouping of the various companies in the glass container industry and had made some abortive approaches. However later in 1966 the company accepted an invitation to join Rockware Glass Limited who had just acquired the Garston Bottle Company. Mr. E.G. Turner and Mr. A.D. Morris who was by then the Senior Executive Director, joined the Board of the enlarged Rockware Glass which then controlled some 27% of the glass container industry. The success of the merger was evidenced by the recognition early in 1968 of the new Rockware Glass as the pacemaker in the industry. Obviously the spirit and determination which animated Mr. John Forster in the early years exists in the new surroundings.

FINALE

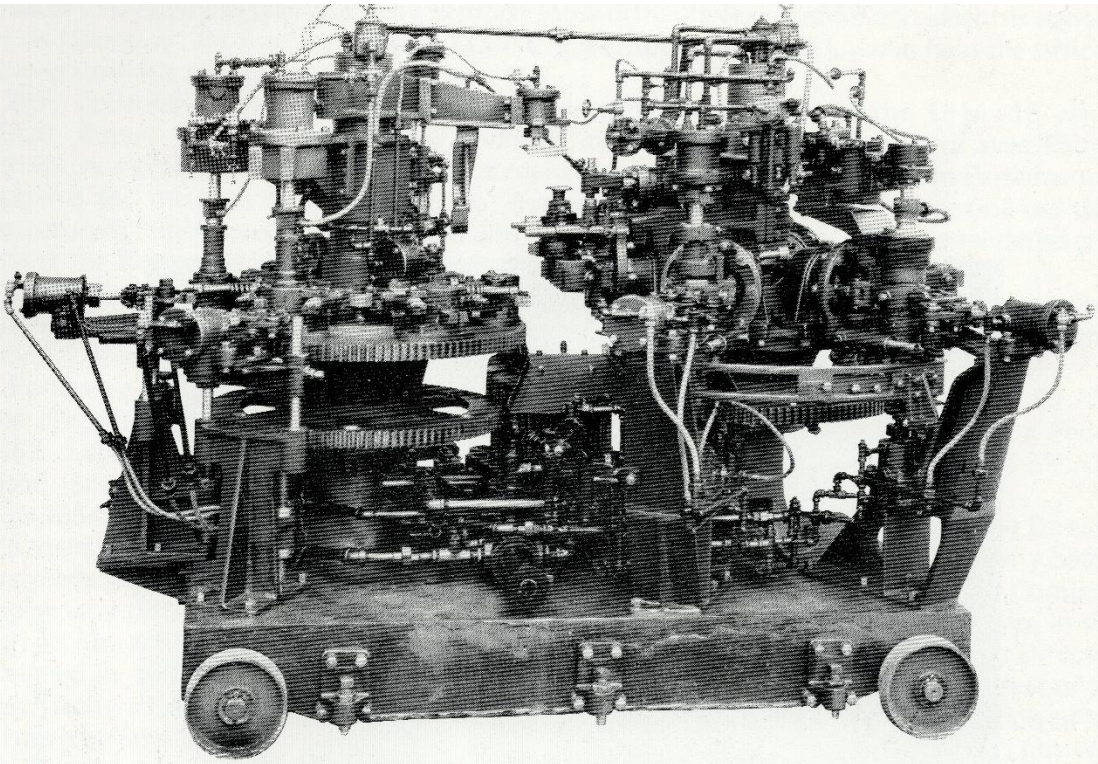
On 1st January 1968, Rockware Glass absorbed Forster's Glass Company, and the St. Helens factory and offices became an integral part of the Rockware organisation.

It goes without saying that Forster's employees would give a good account of themselves in their new organisation.

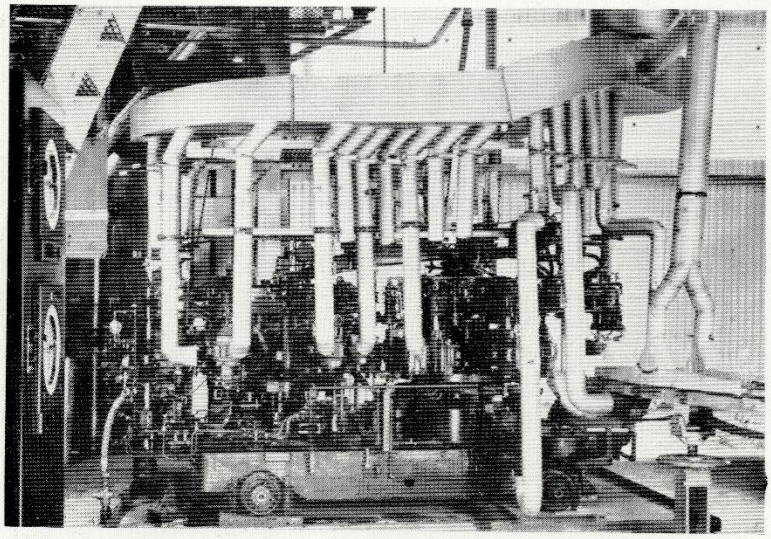
Thus this historical record is ended.



SEMI-AUTOMATIC FORSTER/BOUCHER MACHINE



O'NEIL MACHINE



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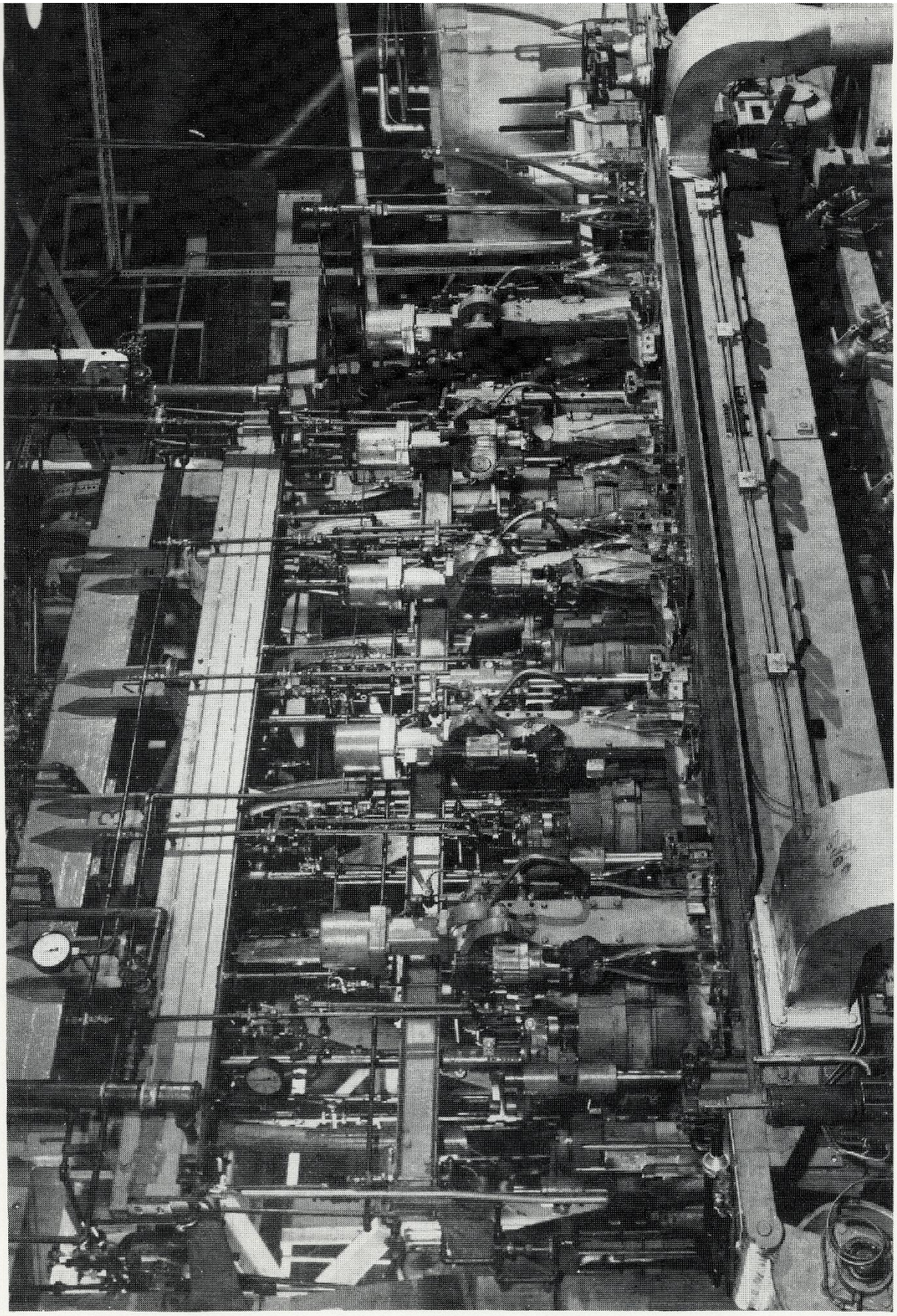
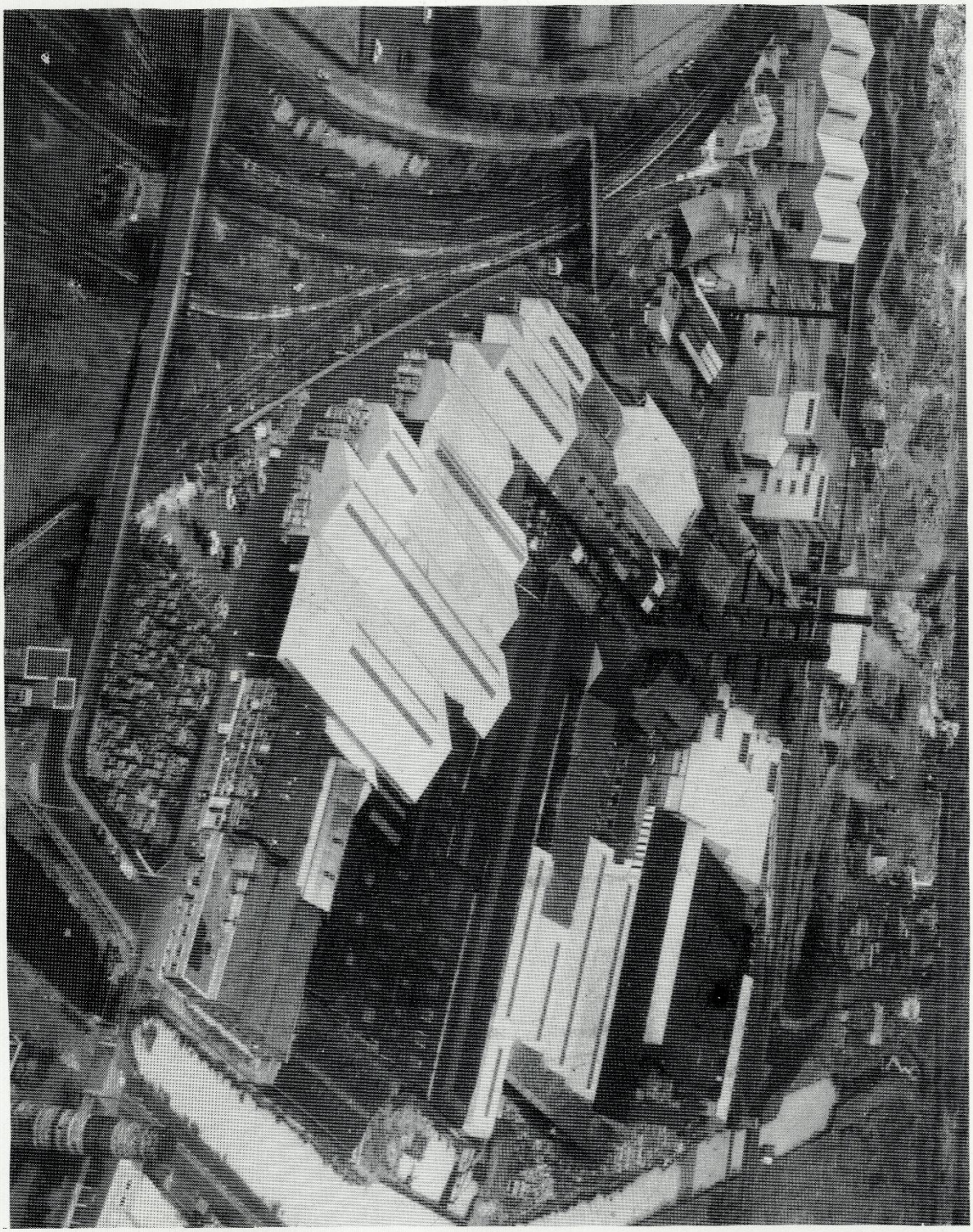


HARTFORD EMPIRE I.S. 5–SECTION MACHINE



AERIAL PHOTOGRAPH OF THE POCKET NOOK SITE IN 1964

APPENDIX I

Reprinted from GLASS, April, 1924

THE ATLAS WORKS

OF THE

FORSTER'S GLASS CO. LTD.

Chairman

JOHN FORSTER, O.B.E., J.P.

Chairman	–	The English and Scottish Glass Bottle Manufacturers' Association
Member	–	National Glass Joint Industrial Council for the Glass Manufacturing Industry
Member	–	Council of the Glass Research Association

Alderman of the County Borough Council of St. Helens, having been a member continuously since 1884.

THE MASS PRODUCTION OF GLASS CONTAINERS

A Visit to the Atlas Works of the Forster's Glass Co. Ltd., St. Helens

A Record of Remarkable Progress

It is now generally realised and appreciated that the manufacture of bottles and containers on a mass production basis is becoming more and more a question for the engineer and his technical brother, the chemist. The old style glass hand is fast disappearing, being replaced by the machine attendant under the control and supervision of a highly trained technical staff.

The full truth of this statement was brought forcibly to our notice the other day when we had the opportunity of visiting the Atlas Works of the Forster's Glass Co. Ltd. at St. Helens, Lancashire, because wherever it is possible to perform an operation mechanically instead of manually, the mechanical method has been adopted.

The business was originally founded in 1900 by Mr. John Forster, J.P., the present Chairman of the Company, and being primarily established as an engineer, he was quick to realise that machinery was destined to play a very important part in the glass industry. Accordingly, he purchased the British Patent rights for the semi-automatic bottle machine invented by Monsieur Claude Boucher, of France. This machine was used and developed during many years by the Forster Company for the manufacture of practically every description of bottle, and incidentally its introduction into this country made the Company one of the pioneers in the manufacture of machine made narrow neck bottles. At the same time a considerable number of machines were made and sold to other glass manufacturers, both at home and abroad, and the "Forster" machine is still recognised in the trade as being one of the best for making internal screw.

Automatic Feeders and Machines installed

In accordance with their principles of obviating hand labour wherever possible, several of the earliest feeding devices of various types were installed, and after a considerable amount of experimenting, methods were developed which gave entire satisfaction and these are now in operation throughout the works in conjunction with the latest automatic glass forming machines. One or two semi-automatic machines are still kept, however, to deal with orders for very small quantities, but with these exceptions all skilled "glass labour" had been abolished.

Since its inception the Company has always worked along individual lines, and we were informed that at the present time they are still an independent firm – not being members of the Association of Glass Manufacturers of Great Britain and Ireland – and entirely outside any kind or form of control. Whilst possibly some people may doubt the wisdom of this policy, it must at once be admitted that in this instance, at any rate, the position taken up by the Company has not had any ill effects upon their business, as we saw containers being made for many of the largest users in the country.

Excellent transport facilities

At the present time the works cover an area of 15½ acres and are exceptionally well situated from the point of view of transport facilities, both for the coal and other raw materials required, as well as for the despatch of the finished products. Sidings connected with the London, Midland and Scottish Railway Company's system are provided at one end of the works, and with the London and North Eastern system at the other end, whilst the St. Helens Canal which forms one boundary of the site, provides direct communication with the River Mersey.

On arrival, the raw materials are unloaded at one or other of the batch stores, depending upon the colour of glass for which they will be used. The mixing is all performed mechanically by machines of the Smith type and the batch is then taken by means of the overhead electric runway to the different furnaces.

This overhead runway installation which was constructed by Herbert Morris and Co. is very complete and is used for the handling of all batch for the furnaces, coal to the producers, ashes, cullet, etc. and in this way the actual roadways are kept clear of all obstruction. The runway delivers the batch into hoppers from which it is automatically fed into the furnaces or tanks as

required. All the tanks are constructed in accordance with the latest European and American practice and design, special precautions being taken to facilitate repairs should they become necessary.

Gas Machines Installed

The gas required for heating the tanks is provided by a battery of Morgan Automatic Gas machines. As has been mentioned previously, the coal is delivered into the storage bunkers by an electric grab and from here it is fed into the producers automatically. The gas supply from these machines is very regular, both as to quality and quantity, resulting in the temperature of the furnaces and lehrs being kept constant within fairly fine limits.

After being melted and refined in the usual way, the molten glass flows into the various feeding devices which are placed round the "working end" of the furnaces and deliver it to the forming machines. The object of the feeders is to supply the glass to the machines in "gobs" of constant weight and shape for each type of bottle or container. After being blown or pressed to shape in the forming machines the bottles are passed through lehrs to be annealed, these lehrs being of the continuous belt or chain type.

Accurate Control of Quality

A very elaborate system of temperature measuring and recording apparatus is installed, records being taken of the melting furnace temperatures and also at different points along the length of the lehrs.

In order to obtain a constant check upon the quality of the glass-ware being produced, samples are taken from each lehr at regular intervals throughout the 24 hours, and are submitted to hydraulic pressure tests and various sterilising and capping tests, etc. to ensure that the requisite standard is being maintained continuously.

As will easily be realised the warehouse accommodation necessitated by a works of this size with a weekly capacity of almost 25,000 gross of bottles of various kinds, is very extensive, and special railway tracks have been laid to enable trucks to be brought into the various warehouses for loading under cover.

Works almost self-contained

A somewhat unique feature of these works is the extent to which they are self-contained, or in other words the very small amount of work for which it is necessary to have outside assistance. As an example, all the moulds required are made on the premises, a well equipped pattern shop, small foundry and machine shop enabling this to be done. This has proved to be a great advantage, as not only does it enable the quality of metal used in moulds to be under control, but it is of the greatest value in facilitating the firm to deal extremely promptly with any rush order for bottles or containers of a shape necessitating new moulds.

At the time of our visit a considerable variety of work was in progress in this department, including moulds required for bottles to contain such divergent products as ink and milk, sauces and adhesive pastes, beer and Bovril, etc., etc.

The works is also fortunate in possessing an extremely well equipped chemical laboratory with a staff of assistants. Here samples of all the raw materials used are examined as they arrive. These tests are not made spasmodically but as a part of the regular routine of the factory and the proportions of the "batch" are changed in accordance with the results of the analysis and tests. In this way, combined with regular and frequent tests of the glass in the furnaces, the high quality and strength of the containers is constantly maintained.

Amongst the other departments, may be mentioned the pot or refractory shop, where the various special fireclay and potclay parts required for the feeding devices, etc. are made. Alongside is the masons shop, which is provided with machines and plant for the dressing and preparation of the fireclay blocks and tiles used in the construction of and repairs to the furnaces, etc.

Until recently it was the custom to pack bottles in straw and sew them up in mats, but at the present time the tendency is for buyers to prefer packing in crates, with the result that a special crate making shop has been built and equipped with the requisite machines to deal with the requirements with the minimum amount of labour.

The millwright's department carries out all the running repairs to the plant, locomotives,

wagons, etc. whilst other departments or branches exist to deal with practically any circumstance that arises.

In walking round the different shops, we were somewhat surprised to see the great variety of ware being manufactured, both as regards size and shape and also colour, amongst others there being dark green, white flint of excellent colour and also amber, whilst the types of bottles were too numerous to detail here. Another feature which was very noticeable was the cleanliness of the shops, especially round the forming machines which in many works are only too frequently surrounded by broken glass, oil, etc.

An American Expert's Opinion

Last year these works were visited by Mr. H.L. Dixon, the head of the well known American firm of glass works experts. On his return to America he stated in an interview published in the "Glass Worker" that he had "found this factory equipped with more modern appliances and more nearly up-to-date than any other plant I visited in England, and they still continue making improvements," an opinion which our visit enables us to corroborate.

In conclusion we should like to express our thanks to Mr. John Forster, O.B.E., J.P., for his permission to visit and describe the installation and to his sons Mr. Walter Forster and Mr. W.A. Forster who are in charge of the works, for so kindly showing us round and explaining the different items of interest.

APPENDIX II

FORSTER'S GLASS CO. LTD.,

St. Helens, Lancashire, England

Booklet Prepared for the Visit of

Deutsche Glastechnische Gesellschaft,

May, 1930

FACTORIES, OFFICES and DEPOTS

St. HELENS, LANCASHIRE

1. Atlas Works
   Parent works, occupying 5 acres and comprising at the present time:—
   Main Offices, Main Engineering and Mould Making Shops, Pattern Shops, Foundry, Main Engineering Stores, Garages, etc.

2. Pocket Nook Works
   Main works, covering an area of 16 acres and comprising the following:—
   Melting Furnaces (Tanks), Annealing Shops, Producers, Raw Material Stores, Batch Mixing Rooms.
   Warehouses for storage, washing, packing and despatching.
   Compressor houses, Power house, and Boiler house.
   Fitting shop, Smithy, Woodworking Dept., Electricians' shop, Mould store and Mould cleaning shops.
   Refractories store (Tank blocks, etc.) Refractories workshop, and Pot-room.
   Offices of Production Dept. Superintendents, Warehouse Offices, Drawing Office, Records Office, Foreman's Offices, and two main Works entrance lodges and offices.
   Chemical Laboratory, Physical Laboratory, Testing Room, Experimental Furnace Room, etc.
   Men's Canteen and Women's Canteen.

LONDON

Office — St. Margaret's House, 57/9 Victoria Street, S.W.1
Telephone, Victoria 9068
Depot — Barge Wharf
London & North-Eastern Railway Goods Station,
Marylebone, N.W. Telephone, Paddington 7258.

GLASGOW

Office — 382 Central Chambers, 93 Hope Street,
Telephone, Central 2609.

HISTORICAL

The business was founded as a private undertaking in the year 1905 by the late Alderman John Forster, O.B.E., J.P., and was originally concerned in the manufacture of green glass bottles by the famous semi-automatic "Boucher" machine.

The Company had the distinction of being the first concern in this country to make narrow neck bottles by machinery, and also to introduce into this country the annealing lehr in place of the kiln, which up to that time had always prevailed. After a few years the "FORSTER" bottle machine, an improvement on the "BOUCHER" was designed. The "FORSTER" machine became famous for the manufacture of all narrow neck ware, especially with internal screws; these screws were made by fitting an adaption (patented by the Company) to the above machine, and this was the first machine in the whole world to make internal screws. Numbers of these machines are still in use where semi-automatic machinery is employed.

Between the years 1916 and 1920 considerable expansion took place, the manufacture of colourless and amber glass was undertaken, in addition to the production of green glass, and the Company took a prominent part in the introduction into this country of fully automatic machinery for the manufacture of bottles and jars, by adopting feeders to deliver the glass from the glass tanks into automatic machines, thus doing away with the gatherers. For several years now the factory has been fully automatic, using "drop-feeders" for delivering the glass into the machines.

In the year 1905 the undertaking was incorporated as a Private Limited Company, and in 1919 converted into a Public Company under its present style, with the late Alderman John Forster as Chairman of Directors, and his two sons, Mr. Walter Forster and Mr. William A. Forster as Joint Managing Directors.

The history of the Company has been a record of continuous progress, until to-day it stands second to none in personnel, equipment, efficiency of production and in the goodwill of its customers, not only in this country but throughout the world.

The Company specializes in the manufacture of the very highest quality of glass, thus ensuring great toughness and strength. To this end a large research department is maintained by the Company, in which every possible test is applied to the ware as it is manufactured. During recent years, with the aid of this department, extraordinary strides have been made, so that all the different types of ware produced now conform to the highest standards of strength and durability when subjected to the most searching tests demanded by the stringent conditions of modern usage.

At the end of the year 1927 the Company suffered a grievous loss in the death of its founder, Alderman Forster, but the traditions of the Company, so firmly established by him, have been continued by his successor as Chairman of Directors, Sir Sydney H.H. Henn, K.B.E. In following these traditions the Company has always preserved a wide outlet upon glass manufacture in general, as opposed to the narrow domestic outlook, and in particular has encouraged the Technological side of the Industry. The present Chairman of the Company was the first President of the Glass Manufacturers' Federation of this country, and took a prominent part in the first British Glass Convention in 1928, whilst representatives of the Company have always been identified with the activities of the English Society of Glass Technology, and of the Glass Delegacy of the University of Sheffield.

It is in keeping with this spirit of the encouragement of Glass Technology and with this wide outlook upon glass manufacture in general, that the Company welcomes to-day the German Society of Glass Technology, and trusts that this visit may forge another link in the chain of friendship that binds together all interested in the great and ancient Industry of Glass.

GENERAL

1. The works are concerned with the manufacture of bottles and jars in colourless, amber and green glass.

2. The bottles are supplied chiefly to the beer, wine, spirit, mineral water, milk, cordials, sauces, ink, disinfectant, patent medicine and gum trades.

3. The jars are supplied for jam, marmalade, preserves, pickles, patent foods, cream, sweets, proprietary medicines, etc.

4. The manufacturing capacity of the Works runs to hundreds of millions of bottles and jars per annum, and the tonnage of glass melted is correspondingly great. More and more glass is being produced annually and during the past four or five years improvements in furnace design and performance have doubled the productive capacity of the Works without any increase in the number of furnaces in operation.

5. The glass is melted in tank furnaces of the "cross flame" type. These tanks vary in capacity from 25 to 65 tons per day of glass melted.

6. Fully automatic machinery is employed, "O'Neill" machines of different types being in general use.

7. The machines are fed with glass by "drop-feeders", principally of the "Rankin" type, although in some cases the "Hartford" Empire Single Feeder is used.

8. The ware is annealed in gas fired belt lehrs, specially designed and constructed by the Company, but recently a number of "Hartford" lehrs have been put into operation in order to obtain clean ware.

9. After sorting and testing, the ware is stored in huge warehouses which are a striking feature of the Works. According to the English custom heavy stocks of ware have to be carried for the very numerous customers.

10. All the tank furnaces are fired by producer gas. One small tank is fired from a single producer of the type known as the "Chapman" Agitator. The other tanks in the Works are fired by gas produced from a large battery of "Morgan" gas machines; this battery is practically automatic, requiring a minimum of attention. The producers are self-charging and self-cleaning.

11. The fuel used on the producers is coal, for which this part of Lancashire is famous, all the coal used by the Company being obtained locally.

12. A very large supply of town's gas is required by the Company and special mains are run from the St. Helens Corporation Gas Works right into the Works in order to meet this demand.

13. Fuel oil is used in a number of instances for feeders and lehrs, and also on the tanks during burning-out periods, all the tanks being fitted up with oil as a standby.

14. Steam, for the producers and emergency cooling on the tanks, is obtained from a battery of boilers of the "Lancashire" type.

15. A large amount of compressed air is required to run the various bottle machines and feeders, and a large department complete with air compressors of varying types is necessary to cope with this demand. In addition, a very large number of fans are required for cooling the furnaces, the machines when at work, and for ventilating the positions occupied by the operators. These fans are mostly of the "Sirocco" type, driven by separate motors, where required.

16. The raw materials for melting are mixed in two batch-mixing departments – one for colourless glass and the other for coloured. Four large automatic mixers of the "Smith" type are employed. These machines are capable of dealing with hundreds of tons of batch per day. A very elaborate system of weighing out the different ingredients is in operation in conjunction with these mixers in order to ensure perfect glass.

17. The batch when mixed is transported to the various furnaces by means of an electrically-operated overhead runway. This runway is very complete, being equipped with three electric travelling cranes; in many cases it runs right over the filling stages of the different tanks and delivers the mixture, as well as the cullet right in front of the furnace where required.

18. All moulds required are made on the premises, well equipped machine shops, containing the latest types of labour saving forming machines, pattern shops, and a foundry where the Company makes its own castings of special metal, enabling this to be done. The mould storage, of necessity on a large scale, has received special attention, and includes a shop specially designed by the Company's own experts for electrically cleaning the moulds.

19. One important department is that devoted to the storage and working of tank blocks, etc., since the designing and construction of the furnaces is part of the routine work of the factory.

20. The laboratories include chemical and physical laboratories, testing rooms, experimental furnace room, and a refractories shop.

21. The transport facilities of the Works are excellent. The factory is served by two important railways – the London Midland and Scottish, and the London and North-Eastern, and inside the Works there are 1½ miles of railway sidings available. In addition, a large transport fleet is kept fully employed by the Company in delivering goods to customers.

The following information regarding specific points in manufacture may be of interest:–

"RANKIN" FEEDER

This feeder has been entirely developed and constructed in England, and is recognised as being extremely successful in operation. The feeder proper consists of an extension or forehearth to the furnace built up of insulated refractory blocks, carried in a cast iron casing. The molten glass passes from the furnace to the forehearth or boot through a throat block of a special shape into a circular "nose". In the bottom of this "nose" is a small circular hole or orifice through which the glass is extruded by the movement of a vertically reciprocating plunger.

Surrounding the plunger is a refractory sleeve capable of being raised or lowered at will by a hand-wheel. Owing to the plunger working inside this sleeve its action is localised, whilst the height at which the sleeve is placed enables the weight of glass ejected by each stroke to be controlled within very narrow limits. After being forced through the hole in the bottom of the feeder, the sausage-shaped piece of glass is severed by means of pneumatically operated shears The piece of glass cut off is known as a "gob", and it falls into the waiting parison mould of the forming machine.

The "brain" of the equipment is to be found in the cam-box, which is always placed away from the direct heat of the feeder. By means of this cam-box the timing of the various movements is adjusted both as to the actual duration of the movements and also their time relative to one another.

The "Rankin" feeder is sometimes fitted with gear which enables the sleeve to be rotated when this is considered necessary.

"O'NEILL" MACHINE

This machine consists of two circular tables, each carrying six (or eight) moulds and each rotating round a central column carried by a very firm base. The machine is driven by compressed air and controlled automatically in all its actions by air valves. It is also synchronised to work with the plunger and cutting-off shears of the feeder.

The table immediately beneath the feeder carries what are known as "parison" moulds. In these the neck-ring and neck of the bottle or jar are formed and the article partially shaped in the body. The second table carries the "blow moulds" in which the article receives its final shape. The two tables rotate and pause together.

The making of a bottle can be described as follows:–

1. The "gob" of glass drops into the first parison mould which is in an inverted position with the neck-ring and "plug" at the bottom.

2. As soon as the "gob" is in the parison mould, a plate slides over the bottom and closes it. A valve is then opened automatically and compressed air entering forces the glass round the plug at the bottom and into the neck-ring. The plug serves to pierce the lump of glass leaving a hole for air to enter subsequently and blow the bottle.

3. The plate next slides back, the plug is withdrawn, and the table rotates, the mould passing on to the next position.

4. At this point a solid head or "baffle" is pressed down upon the parison mould to close the opening and air is admitted from below, blowing the glass to the shape of the parison mould.

5. The baffle is now removed and the table once more rotates. During this rotation the parison mould revolves so that when it is nearest the blow table it is no longer inverted but is neck upwards.

6. As the table stops the mould opens, leaving the parison "blank" as it is called, suspended by the neck-ring. This "blank" then moves across until it is over the corresponding "blow mould" on the second table.

7. The blow mould now closes on the glass and simultaneously the neck-ring opens leaving the "blank" in the blow mould.

8. The table once more rotates and at the next stop a "blow-head" descends over the glass neck-ring. Compressed air enters the "blank" and the bottle is blown to fill the blow mould, the inside shape of which is that of the body of the bottle.

9. At the next stopping-place of the "blow" table a further blowing may take place or the mould may move on to the final position when the bottle is removed, either automatically or by hand. It is placed on a conveyor from whence it is transferred to the annealing lehr.

THE "MORGAN" GAS MACHINE

Each producer of the installation of "Morgan" gas machines in the factory has a diameter of 10 feet and the heating chamber is 6 feet high. 3,000 lbs. of coal can be gasified per hour in each producer. The coal is fed automatically into the producer direct from an over-head hopper and is levelled in the producer by a "U" tube water-cooled roller which "floats" on the fuel bed, keeping the coal level and evenly distributed. The producer is worked with a blast of mixed steam and air, which is delivered in the interior of the fuel bed by three hollow radial arms and a hollow ring round the whole circumference.

The producer is water-sealed and slowly revolves as does the ash-pan which is fitted below it. A suitable spiral shaped plough is fitted in the ash-pan and sweeps the entire producer bottom automatically, causing a uniform settling of ash. The ash-pan is supported on three wheels each two feet in diameter with dust proof bearings, and the power required to drive the whole producer is about 0.75 horse-power. This power is doubled for the short period during the periodical automatic ash removal.

APPENDIX III

A Booklet Issued to Shareholders and Customers

In March 1947

COMRADES IN ARMS

How Forster's Glass Co. Ltd., Served the War Effort

PREFACE

by the
Managing Director
FORSTER'S GLASS Co. Ltd.
of St. Helens, Lancs.

This booklet gives an account of our Company's part in the great total effort of war.

The Foreword, although written by myself, would in happier times have been issued in the joint names of my brother – the late W.A. Forster – and myself, but I am sorry to say my brother died on 25th September 1945 after a lifetime spent with our firm, by all members of which he is affectionately remembered.

I am aware that as a result of the war many of our customers have been deprived of the services and supplies which normally would have been available. Although the story of these pages does not set out to offer any apology, it does provide an explanation of the situation with which we were forced to contend.

Control of supplies and priorities of manufacture still exist, and the future will still have its difficulties, but we are not daunted, and all our employees and staff are working hard to give the highest possible standard of quality and service to all our customers.

(Signed) WALTER FORSTER

Managing Director

March 1947.

CHAPTER ONE

INTO THE BOTTLE NECK AND OUT

"Bottle Necks" are a sine qua non of the glass industry! Figuratively speaking, they are a part of our very existence. It is, however, not in any light-hearted vein that the phrase is used to introduce these pages. "Into the bottle-neck – and out" summarises a host of problems which war conditions compelled us to accept and which, in no small measure, were overcome. Happily the grim years of blood, toil and sweat now belong to the pages of history, and this little book is a small contribution to that record of cataclysmic experience and fire-proven endurance through which we, and our fellows, passed.

It is a far cry to that Sunday morning in September 1939, when church bells, wont to proclaim their peaceful message, were echoed instead by the harsh din of strife and war. Only too soon were we flung into the maelstrom of disorganisation, uncertainty and improvisation which in the hard school of those years we learned to accept as normality.

The first difficulty we had to face was the loss of trained personnel to the Forces; men who were in the Territorial Army, a service to the nation which we had always encouraged, and those of the Army and Navy Reserve. Further, we put no obstacles in the way of those of our employees, whether from the Staff or Works, who wished to volunteer for one of the three Services. In the first twelve months of the war we contributed 349 men to the Services. Every one had our definite promise that his job would be available for him on his return and that he would rank for promotion and for increase in emolument just as if he had remained at home. Every one was made a weekly allowance which was paid either to himself or to his relatives at home.

The Service-man's pay book was a symbol of the nation's responsibility to him, but we do know something of the appreciation our own men feel for the extra security provided by that never-failing pay-packet by which we, as a firm, were able to ease their apprehension for the welfare of their families. For so long as any employee remained on active service this financial arrangement held good.

The labour problem became more and more difficult as the war progressed. Mr. Ernest Bevin was casting his net wider and ever wider. Our younger men were being called up for service with their age and service groups. These were all skilled or semi-skilled workers, and, in general, they had to be replaced by women, who of necessity had to be trained before they could undertake the work they were now to handle. Men of over military age, many of them old-age pensioners and veterans of earlier campaigns, came in to fill the gaps in our yard labour-force. From the outbreak of war to V.E. Day, not far short of 650 male employees downed tools to take up the weapons of war in the Services. Even this was not the end of our labour troubles, which began to run in a vicious spiral. No sooner had we trained members of our considerable female staff of unskilled workers to replace the men in skilled operations, than the drive started for drafting women into the Forces, the Land Army and munition factories. In labour we were burning the candle at both ends.

In spite of the constant drain on our workers, the never-ceasing search for replacements and the consequent time-lag in training before the newcomers could become effective, we maintained our output at its pre-war rate. This was achieved by the whole-hearted co-operation of our staff and workers who were inspired with the spirit to win through, come what may. The great "Blitz" was now pouring fire and fury from the night sky and a new resolution and endurance were demanded .... and fulfilled. During 1940 and 1941, when the Luftwaffe made its onslaught on Lancashire and the Western sea approaches, we worked through the "alerts" and only ceased at moments of immediate and intense danger.

London's burning ..... London's burning .....
Fire, fire ..... Fire, fire .....

– so runs the old familiar round! St. Helens also had its moments!

It was not only conditions at home that were causing us so much concern. The campaigns

in Europe were adding their burden to our specific problems, just as they were doing to the overall national effort. The fall of Norway early in 1940 cut off certain of our raw materials, and the over-running of Belgium compelled us to seek other shores for a considerable amount of our supplies of sand. For five years we have had to use for our processes a proportion of sand inferior in purity compared with pre-war standards, and the same applies at the present time. In spite of the restriction of raw materials, we have been able to preserve the high standard of strength in our glass and, in certain directions, have even made improvements. There has been a slight falling away in the "colour" of our white flint glass, but this is the only instance of quality being affected by the abnormal conditions in which we were, and are, operating.

At this stage, "Old King Coal" was proving anything but the genial counterpart of his nursery namesake! Pre-war, we insisted on procuring only the finest grades of coal for firing our glass furnaces, but early in the war the diversion of these grades for priority quotas, left us to make the best use we could of poorer types of coal. That we did make good use of them, is proved by the fact that the efficiency of melting and production was not impaired. Here again, a combination of research, improvisation and the "never-say-die" spirit of all concerned kept production at a high level, although considerable extra expense of effort, skill and finance was involved.

Our war-time dilemma, so far as this record has been concerned, has revolved around the twin problems of labour and supply. There was a third major emergency demanding attention – that of plant depreciation. The severest restrictions were imposed in the control of supplies of machinery and other equipment. For the whole period of the war we were prohibited from purchasing any new bottle-making machines and supplies of metal for spare parts, repairs and mould-making were strictly limited. This handicap became progressively worse because the wear and tear on automatic bottle-making machines working continuously day and night throughout the war years, and on the moulds, was enormous. However, ways and means were found to preserve our rate and quality of output.

The manufacturing potential of the country was gradually being geared to serve the war effort as a whole and, in the nature of events, the functions of Forster's Glass Company found their place in the general scheme. Our manufacturing was primarily concerned with food and beverage containers, and their importance led in 1942 to our being scheduled under the Essential Works Order, and since then our output has been under the aegis of the Ministry of Supply and the Ministry of Food, with lately the Board of Trade acting as the Production authority. As a result of the priorities laid down by Ministry requirements, certain interesting figures emerge which point to the direction and scale of our work. Milk bottles were an item of intensive concentration, and our output of pint milk bottles is now greater by 70% than in 1939. Later, as our armies extended their march of conquest to the distant parts of the world, the output of bottles to send beer to the troops in Europe and the Far East was stepped up to meet one more Churchillian challenge.

Our output at this time could be summarised under three main headings:–

1. Food Containers. (Milk Bottles, Jam Jars, Vacuum sealed Jars for Fruit preserving, Jars for Food Extracts, etc.)

2. Service Stores.

3. Beverage and Medical Bottles. (For Service and civilian requirements.)

It is an interesting commentary to note that the overall production figures for these three groups represent an increase of 17% for five war years as compared with a similar period immediately preceeding the war.

When these facts are associated with the tale of adverse conditions which earlier paragraphs have described, we feel that we can claim a share in the success of those hard but stupendous years. At Forster's we played our modest part in forging the chain of survival which links the housewife – "keeping the home fires burning" – to her man enduring the sinister dangers of the mosquito-ridden jungle of Burma. Only a bottle – the one a milk bottle, the other maybe a medicine phial – but both the visible representatives of our contribution to the massive scheme of victory.

This is a story of emergencies and improvisations. To the casual reader the temporary

meet new and constantly changing conditions with prompt and effective action, depend on wide experience and technical knowledge.

In short, we were in a position to draw on the capital of the past.

In pre-war days we had built up a sound organisation, well balanced and progressive, for meeting the new conditions imposed by war. Our factory was equipped with modern automatic machinery for glass container manufacture of all kinds, and our workers had been trained in the most up-to-date methods of mass production. Our staff of engineers, technical experts and research chemists – several of them men of the highest reputation in the Industry – played a leading part in maintaining through the six years of war so great a volume and standard of production.

An intrinsic part of our equipment and works is the mould-making plant and well-planned engineering shops. In the first World War (1914–1918) the shops were used for shell and munition production, and history was to repeat itself when war again broke out in 1939.

But that is another story. It is the subject matter for Chapter Two.

CHAPTER TWO

1,500,000 TARGET

Before the outbreak of war, plans were at an advanced stage for building a larger engineering shop for the production of moulds. It was decided not to abandon the project in order that the new building might be made available for the war effort. As a result, in April 1940, a fine new shop, with a floor space of 5,000 square feet, was put at the disposal of Ministry of Supply requirements, and we were commissioned to handle the manufacture of medium-calibre ammunition.

The following paragraphs might be described as our production "log" for the first sixteen months of our activity in munition output.

May 1940

The new single-purpose machines which we had previously ordered were being delivered, and these were installed, tooled-up, given a trial run and generally brought up to service capacity.

Towards the end of the month female labour was signed-on and the first twenty women were put through a training course. As they became efficient, others were drafted in for training. A point of considerable interest is that among these workers were some who served in Forster's munition production in the 1914–1918 war.

June 1940

By the 16th, it was possible to commence 24 hours per day operation with three 8-hour shifts – 7½ working hours and half-an-hour for a meal.

The first 2,000 shells were despatched to the filling factory on the 11th. When production had been in progress ten weeks, output had reached 3,445 shells, although operators were still being trained and the complement of machine tools was not completed.

July 1940

The first contract was termed "educational" by which the Ministry of Supply and our Directorate could test the efficiency of the workers so far trained and the plant so far installed. This contract covered 50,000 Quick-firing, High-explosive, 3-inch, 20-cwt., 16-lb., Mark II., B/L Shells – to give them their full descriptive title. Gunners of the earlier war may recognize this shell as a former friend.

August 1940

The news now came from the Ministry of Supply that the second contract would cover 100,000 Q.F., H.E., 18-pdr., Streamline Mark II. C/L Shells. This simple announcement carried

its own train of problems, as the manufacture of the 18-pounder shell involved new tools, former plates, etc., for our machines. This was a "facer" for the tool room, particularly as originally we had only one toolmaker in our engineering department. Fortunately we found that several of our mould fitters proved apt pupils, and we trained them to become skilled toolmakers.

October 1940

The 8th day saw the first contract completed, and the following day preliminary operations were started on the 18-pounder.

Incessant air raids compelled the suspension of the night shift and, in fact, we worked only two shifts for the remainder of the war.

At this time,we qualified for designation by the Ministry as a "single unit" plant – a term to denote the capacity to produce 2,500 shells in a single of 7½ working hours.

March 1941

Speed of output reached the satisfactory rate of more than six shells per working minute; 5,600 shells being produced in 900 minutes.

The 18-pounder contract was completed at the end of the month and a repeat order for 100,000 was put in hand.

September 1941

The repeat contract was completed.

What was happening outside our munition shop during these months? Let us not be too parochial with our memories, for the period is one of history's great chapters. The Russo-Finnish martial sideshow had ceased and the arena was cleared for the main struggle. Denmark...Norway ...the Low Countries...Belgium...France...all Europe was Hitler's playground. But there had been Dunkirk; one insignificant point on a Continent's vast coastline, yet its disaster was the precursor of victory on nearby Normandy sands four years later. Winston Churchill by word and deed, was scaling events to their relative proportion. He had immortalised "the Few" who had saved us from the invasion of the skies – the Battle of Britain had been fought and won. He had proclaimed "our finest hour" when any but the bravest might have been excused for anticipating the moment of defeat. Blitz, bombs, and fiery nights were bringing the war right home to the doorstep. What were we to do in the face of these events? Carry on with the work; "every man to his job" was the order of the day and the plan for victory. That was our task, and we did it.

During the next twelve months we handled a considerable amount of experimental and research work for the Ministry of Supply in addition to the contracts shown in the table which follows:–

Type	Quantity	Started	Finished
1. Mk. VII. 6–pdr. H.E. Shells	80,000	7 Sept., 41	4 Mar., 42
2. 3–in. 20–cwt. Semi Armour-piercing shot	10,000	28 Sept., 41	7 Nov., 41
3. 75 m.m. Semi Armour-piercing shot	25,000	9 Nov., 41	27 Mar., 42
4. 6–pdr. Mark IV. Proof shot	7,000	16 Nov., 41	1 Dec., 41
5. 3–in. 20–cwt. Armour-piercing shot	60,000	19 Apr., 42	17 Sept., 42

In spite of the fact that we were operating only a "single-unit" plant, with barely adequate tool room facilities, we were able to handle these overlapping contracts with speed and efficiency, and we are proud of the achievement. There is a great deal more than meets the eye in this table of bare figures and facts.

For instance, No. 4 (6-pounder Proof shot) was a priority job as this ammunition was required to proof new guns. Mass production was ordered to a tolerance in weight of 2 drams. As the shot was only 5¾ inches in length and approximately $2^{3}/_{16}$ inches in diameter, the tolerance of 2 drams represented the infinitesimal variation of one – or two – thousandths of an inch in length or diameter. However, in sixteen days the job was done!

No. 5 (3-in., 20 cwt. Armour-piercing shot) presented an entirely new set of problems. Semi Armour-piercing shot had proved useless against armoured tanks and the like, because of its low penetrative qualities. Armour-piercing shot had previously been manufactured from a nickel chrome steel, but the extension of the war to the Pacific had produced a shortage of nickel.

A different type of steel had to be found, and a chrome molybdenum steel was delivered for experimental purposes. The difference in the technique of the heat treatment for the two steels resulted in the establishment of a new heat treat department complete with furnaces, quenching tanks and other necessary equipment. Nickel chrome steel shot is heated and tempered in two stages; chrome molybdenum steel shot in one. Whereas the quenching medium for the former is oil, water is used for the latter, and this presented many difficulties in preventing the steel from cracking. This, and many other attendant problems, was solved by research in heating processes. In early experiments 1½ hours was required to bring the steel to the required heat, but this had risen to 3½ hours when the final method was perfected, which presents some idea of the technicalities that had to be controlled and overcome.

It was not surprising that the "security" silence of the war period accentuated the magic of the phrase "inside information"! If the shot which we produced from October 1942 onwards could have revealed the secrets of its mission, no price could have matched its publication rights! But all we knew was that it was a 17-pounder Armour-piercing shot... it was a brand new ammunition for a newly-designed gun... that it was a "hush-hush" job... that delivery was a desperately urgent matter. So, once again, oblivious of the great events that hung upon our work, we forged ahead and made good use of the special experience we had gained with recent contracts. The shot weighed 17 lbs., was 10 inches long, and was approximately 3 inches in diameter; 125,000 shots were completed between October 1942 and May 1943. Gradually we became aware of its purpose. El Alamein sprang from the map in letters of fire; a beacon of victory. The fame of "Monty" was ever in the ascendant; that of Rommell became ever more dim. The assault towards "the soft under-belly of Europe" was under way, and our 17-pounders were helping in the good work by leaving their mark on German Mark IV. tanks in sandy African wastes. We were to hear even more about the famous 17-pounder – this time in an improved form.

The original 17-pounder would penetrate any German armour known at that time provided the impact was square with the armour plate. Otherwise it would fly off at a tangent. Experience also proved that the Germans were hardening the outside surface of their armour plate and this was blunting the nose of the shot and reducing its penetration power. It was decided, therefore, to fit a "penetrative cap" to the shot which on impact would break up the hardened "skin" of the armour plate and also split the cap itself free from the nose of the shot. Thus a passage was forced by which the shot passed right through the armour plate.

In order to fix this hardened-steel cap over the nose of the shot, three additional operations were necessary, and two new shops of 2,500 and 1,500 square feet were erected to carry out these processes:–

(1) The machining all over of the penetrative cap from a black forging.

(2) Heat treatment of the penetrative cap.

(3) Soldering the penetrative cap to the shot nose.

The production of the cap did not present any great problems and the heat treatment of the cap followed much the same procedure as that of the shot, except that a different type of furn-

ace and quench tank were required, and the cap was stress-relieved in hot air circulating ovens. The greatest difficulty was experienced in soldering the cap to the shot. Although the actual operation of soldering the two components together was reasonably easy, the trouble lay in the fact that both the shot and cap were hardened steel, and it was essential for the operation to be performed without losing this hardness. Monolising was the name given to the entire process, and we sub-divided this roughly into five operations:

(1) Shot body and penetrative cap cleaned by shot-blasting where the two components were joined together.

(2) Shot and cap passed through seperate tunnels of a gas-fired furnace.

(3) The shot and the cap tinned where they were joined together.

(4) The shot and the cap placed in fixture so that they would adhere to each other in a concentric manner.

(5) The monolised shot passed through a neutralising bath to kill the acid used in the tinning operation.

In spite of all this experimenting with new processes, it was surprising how quickly the improved 17-pounder was leaving our works for the Government Filling Factory. By the time production ceased on 4th February, 1944, the total number of 17-pounders we had produced was over 78,000.

The last stage of "this strange eventful history" was still far from a life of slippered ease, and was reflected in our final contract for 150,000 3-in. U.P. Venturi Tubes, a component of the Motor Rocket. This required one more set of adjustments to methods and equipment, including the process of parallel boring to the desired limits. In fact, we produced two different types of tubes:—

(1) "Hot Rolled" which required machining all over.

(2) "Cold Drawn" which were not bored but machined on the outside diameter and at both ends.

Between February 4th, 1944, and October 1945, over 820,000 Venturi Tubes had left the works, and our total target for all ammunition was nearly one-and-a-half-million. Figures tell an impressive tale, but let the final tribute be to human effort, loyal services and the determination of all to know no defeat, either by technical problem or foreign invader.

We could not end this story on a better note than the crescendos of cheering multitudes... it was peace. The job was done! Well done!

APPENDIX IV

Reprinted From "Brewers' Guardian"

NEW AUTOMATIC BATCH PLANT

for GLASS CONTAINERS

FORSTER'S GLASS CO. LTD.

Atlas Glass Works, St. Helens, Lancashire.

FORSTER'S GLASS INSTALL AUTOMATIC BATCH PLANT

Progress of Ten Year Modernisation Programme

Since the end of December 1962, a completely new automatic batch mixing plant has been in operation at the St. Helens Works of Forster's Glass Co. Ltd.

It is claimed to be the most up-to-date installation in any glass container plant in the British Isles and is providing the close degree of control and homogeneous blending of materials essential for high standards of quality necessary to ensure consistently uniform production from modern glass forming machines.

On a recent press visit to the St. Helens factory Mr. W.O. Hinds, joint managing director, told the visitors that since 1954 the company had tackled forcibly a highly concentrated plan of modernisation. They had completely re-constructed the whole of the manufacturing portion of the works on the same geographical area without the loss of one minute's production. In addition, to meet the requirements of customers, they had added approximately 100,000 sq. ft. to covered warehousing accommodation, with a total to date of 200,000 sq. ft.

Early in 1954 they were operating no less than nine different types of forming machines. By April 1961, they had replaced these by two different types of the most up-to-date design for their particular production. This changeover had necessitated the acquisition of new techniques and a complete re-education of personnel.

To enable the new machines to operate at maximum efficiency a complete reconstruction of the melting units was essential. They were re-designed to produce first-class glass quality at high melting rates, consistent with the maximum economies in fuel. Coincident with the reconstruction the factory changed over completely to oil firing for reasons of efficiency of control, cleanliness and improved glass quality.

The maximum use is made of automatic equipment in the control of fuel, temperatures, batch feeding and glass level. In the latter case use is made of radio-active sources for transmitting the necessary signals to automatic control instruments.

Additionally, the firm undertook a rapid replacement of all the feeders delivering and conditioning glass for the machines. These are of the most modern design, complete with fully automatic control. Outstanding technical advances led to the early introduction of dual-cavity production.

Lightweighting

During this same period there were other developments taking place in the world of packaging. In the past bottles had been made at a certain weight mainly because of the inability in the course of manufacture to obtain ideal distribution of the glass to give uniform strength throughout the whole container. With the improvement in melting and forming techniques, Forster's now have more precise control over the pressing or blowing of the bottle. It was a natural development, therefore, that it was found possible to reduce weight and still have an ample margin of safety. Careful re-design of containers to work at the minimum possible weight enabled them to be sold as one-trip dispensable bottles, more than adequate in strength to perform this particular duty.

The careful design of the container, coupled with the high quality of the glass being used, ensures a high safety factor from the point of view of mechanical strength, resistance to thermal shock and the ability to withstand high internal pressures which are experienced in the case of carbonated and pasteurised liquids.

Construction of New Batch Plant Building.

It was during this stage of development that the whole of the technical processes came under the microscope. The decision was made to press ahead with the automatic batch plant. This concerned the basic stages of glass manufacture – storage, handling and mixing of raw materials – and would result in the minimum contamination of raw materials, the maximum

homogeneity and uniformity of glass batch.

The plant is designed to discharge, store, weigh and mix the necessary raw materials for the melting of flint, amber and green glasses, and is housed in a reinforced concrete building covering an area of 8,000 sq. ft. The structure is 79 feet high from the basement level to the top of the tower block. The whole of the raw materials including reserve stocks are carried in the building.

The general scheme was finalised and approved in April 1961. Extensive site clearance and piling was necessary and despite serious interference due to adverse weather conditions, the flint section of the plant started operational trials in September 1962, followed three months later by completion and operational trials on mixing for coloured glasses.

The terms of reference imposed substantial limitations of design:—

(a) Existing production had to proceed without interference.

(b) A site between two existing mixing departments had to be utilised, the foundations being at a substantially lower level than adjacent old buildings.

(c) The main feed conveyor had to have the maximum rise in the minimum length practicable.

(d) The tank batch feed conveyors had to be superimposed on an existing system delivering to fixed bunker storage positions behind the melting units with facilities for providing batch to enable any unit to melt any one of the three colours.

(e) The re-siting of rail and road delivery points for raw materials.

The flow system, therefore, runs from material discharge to the overhead storage bins, through the weighing system via service hoppers to the blenders, thence to the final conveyors to the bunkers feeding the various melting units.

Whilst the heavier tonnage of raw materials is received by rail, facilities are provided permitting the alternative use of road transport. Incoming sands, soda ash and limestones are discharged into bunkers below ground level feeding at controlled rates into elevators to the top floor of the building. Here, depending upon the characteristics of the raw materials, they are distributed by screw or belt conveyors to storage or service bunkers.

Non-bulked materials delivered in bags or casks are handled into store either by a special bag hoist or service lift. Other than arsenic, they are then discharged into service bins as required; arsenic and decolourisers are housed in a special room and are separately mixed from the main materials.

The remaining constituent, cullet, is delivered from the collection point by dumper to ground bunkers for each colour, then elevated by an automatically controlled skip hoist to surge hoppers at the top of the building feeding disintegrators, which in turn discharge by gravity into main service hoppers. In the interests of maintaining high quality, no cullet is used from outside sources.

This basic arrangement enables all materials from the service hoppers to flow by gravity through the weighing systems to the discharge receiving bunker for weighed materials situated at basement level.

The weighed materials are elevated by automatically controlled skip hoists of two tons capacity and discharged into the appropriate batch blender. On completion of the blending cycle, the mixed batch is discharged automatically to the main distribution conveyor for delivery to the furnace conveyor system. Should the necessity arise, a by-pass has been introduced into the system to enable batch to be discharged to vehicles.

Batch for flint glass and one other colour can be weighed and blended simultaneously on a completely fully automatic cycle rated to provide 4,000 lb. of batch of each colour every four minutes. The capacities of the storage and service hoppers are as follows:—

	Tons
Sand for Flint Glass	1,700
Sand for Coloured Glass	750
Soda Ash	570
Best Limestone	300
Common Limestone	150
Dolomite	70
Alumina Hydrate	8
Saltcake	12

Sodium Nitrate)	...	...	...	10
Fluorspar)				
Decolourisers	...	...	...	0.7
Amber pre-mixed materials	...	...	...	2.5
Green " "	...	...	...	3.5
Flint Cullet	...	...	...	65
Amber Cullet	...	...	...	35
Green Cullet	...	...	...	25

With the exception of sand, the same elevator used for conveying bulk materials into stock is used for transferring from storage to service.

The main storage bunkers for sand are of sufficient capacity to permit a pre-determined period of natural drainage of moisture. For this reason a traversing grab is used for transferring supplies from storage to service hoppers positioned over the weighing machines.

The functions of moving materials to store and thence from store to mixing are handled by two completely separate control systems. This was deliberately specified by Forster's to give maximum protection to the movement systems, conserve power and avoid any possibility of material contamination. The plant has a substantial reserve capacity.

So far as mixing is concerned, for reasons of convenience and control the operation is spread over 24 hours per day, but is only working intermittently.

The weighing, mixing and delivery of batch is a fully automatic process, initiated from a central control room situated in the basement of the building, containing the weighing machine dials and illuminated mimic flow panels for each colour of glass.

Materials Storage

Other than Sands

All storage and service bunkers are of reinforced concrete construction with bottom outlet cones fabricated from steel. The outlets to all these hoppers are fitted with outflow controls.

The storage bins are fitted with chutes below the outlet gates feeding the material back into the appropriate elevating feeder, to enable the same equipment to be used to transfer from storage to service. All bunkers are fitted with high level bin indicators interlocked to cut out the drive on elevators and associated conveyors.

Indicator lights in series on the conveyor starting panel give visual indication of the stock position. Feed gates on all service bunkers are interlocked and fitted with indicator lights to avoid incorrect routing of materials.

Sands

Sand for flint glass is normally delivered by rail and bottom discharge through a grid into a 20-ton under rail surge bunker, thence by vibrator conveyor to a bucket elevator. The elevator feeds a belt conveyor from which the sand is ploughed off into one of the five main storage bunkers, each holding in excess of 300 tons. The discharge system is rated at 60 tons per hour.

The main sand storage bunkers are open topped reinforced concrete construction arranged to permit an overhead traversing crane to pass over in line. The bunker bottoms have coke breeze slabs to allow natural drainage of the incoming sand. After a period of draining, the sand is removed by grab to the service hopper in sequence according to length of storage.

Sand for coloured glasses is delivered by road into a 25 tons underground bunker. It is conveyed and elevated similar to the flint sand but is deflected into the bunkers by a pneumatically operated multi-position chute.

This system will handle 40 tons per hour.

Soda Ash

Soda Ash is received in Covhop wagons and discharged by pneumatically operated dust-proof teats to an underground screw conveyor, thence into a Redler drag link conveyor and elevator via a screw conveyor to store or service bunker. The same conveyor is also used for removing ash from stock. The unloading rate is 25 tons per hour.

Limestone

The various grades are delivered by bottom discharge rail wagons or road vehicles and handled in a similar way to sand to the top floor. At this point it is discharged into a tubular chute which rotates horizontally to connect to the correct storage bin mouth, or direct to the service conveyor. Safety light indicators show the particular route in use. The discharge rate is 60 tons per hour.

Cullet

This is delivered by dumper into a ground bunker and elevated by an automatic skip hoist to the top floor of the building. Here it discharges into a disintegrator, thence by chute into the service hopper. Cullet for each colour of glass is handled through a separate system.

Bagged Materials

All bagged materials are delivered by road and are elevated to the top floor by a special bag hoist at the rate of 5 per minute. Certain materials received in casks or drums are moved into stock by a service lift.

Weighing and Mixing

The plant is divided into two parts, one for flint, the other for coloured glass batches. The systems are separately controlled but work simultaneously.

Each system consists of five hopper scales preset to weigh out the required quantities of sand, limestone, soda ash, cullet and bulked additives.

Weighing

The sequence of control of all weighing when on "automatic" is controlled by a main combined relay cubicle and control panel which contains all the electric switches, fuses, electronic relays, etc. On the front of the panel are all the stop and start buttons, switches, etc., associated with the weighing control and also situated on the main control station are a number of different coloured indicator lamps which indicate the progress in stages of the weighing cycle. All stages of weighing are interlocked so that final discharge will not take place until a "correct weight" signal has been received at the auto control from each individual weigher.

At this point in the sequence of operation the auto-weighing control hands over to the auto-mixing control panel, and providing that the requisite mixer loading skip is in position to receive the batch, a signal is given and all the weighers simultaneously discharge their contents into the waiting skip. When the discharge is complete a second signal received from the zero-contacts on the weigh heads is received, the hopper doors close, a counter registers one batch complete, and the weighing cycle repeats itself. Each weighing machine is fitted with local control stations which enables each stage of the weighing cycle to be operated by hand should the automatic sequence break down.

Mixing

After the materials are weighed they are discharged into a receiving bunker which in sequence discharges into a skip hoist. This ascends to the top of the tower and discharges into a hopper positioned above the appropriate blender. Three blenders are installed:—

A for flint batch
C for coloured batch
B spare for either colour

The mixing cycle is controlled from a central control cubicle situated in the basement of the batch plant. This cubicle houses the weighing machine heads, automatic control panels and mixing control panels, one set for flint glass batch mixing and the other set for coloured glass batch mixing. All push button stations for operating the mixing machinery are located on the appropriate control console together with an illuminated mimic diagram.

The mixing cycles are controlled by a stepped uni-selector control rotary switch in the mixing control cubicle which will initiate the mixing cycle on receipt of an impulse from the weighing control panel, and does in fact signal "Discharge Weighers" to the weigh control when the mixer skip is in its correct position, which is when the rotor of the uni-selector has "homed"

to position zero.

The mimic diagram is fitted with a system of indicating lights showing the progress of the mixing cycle and also showing a signal light indicating whether or not the distribution conveyors leading from the batch plant to the glass melting furnaces are in action.

The distribution conveyors starter controls are located within the batch plant building adjacent to the point where the batch feeds from the blender discharge to the conveyors. The distribution conveyors are electrically interlocked with the mixing cycle and the appropriate conveyor must be operating or the mixing cycle will stop. The operation of the distribution conveyors is therefore under the control of the batch mixing chargehand.

A further row of signal lights on the mimic diagram indicate the position of the discharge flaps from the conveyors to the furnace bunker.

A sound power telephone installation is sited at all key points in the mixing and distribution system to enable any relevant information to be fed back to the main control room.

APPENDIX V

Reprinted from the Soft Drinks Trade Journal

January 1964

THE ONE TRIP

MINERAL WATER BOTTLE

Survey of an Important New Marketing Trend

by the Editor

In the last few months a new trend in mineral water marketing has begun which could not only change the whole pattern of soft drinks selling in this country but also drastically enlarge the market. Its importance should not, therefore, be underestimated, even at this early stage. We refer to the introduction of the one trip light-weight mineral water bottle on the United Kingdom market.

Pioneered by Forster's

Forster's Glass of St. Helens pioneered the new one trip light-weight mineral water bottle in the same way as they have led in light-weighting in other fields. A recent example of this is their launch of the light-weight sterilized milk pint bottles, also the first in its market.

Forster's initial interest in the marketing of one trip mineral water bottles arose as the result of two studies. The first was of the rapid growth in popularity of the one trip bottle in the United States, where, between 1955 and 1961, the sales quadrupled.

The second was an analysis of future retailing trends in the United Kingdom based on the American experience. In the U.S. the increase in sales of one trip mineral water bottles has brought about a revolution in soft drinks retailing. As a result of the elimination of the cost of handling returns, the major retailing outlets and supermarkets now look favourably on soft drinks and are ready to accept a lower margin of profit than hitherto because of the higher turnover. The abolition of these costs, in fact, frequently turned a lower gross into a higher net profit.

At the same time, Forster's also became convinced that one of the major sales points of soft drink is – and always will be – the pleasing natural appearance of the product itself. Because of these factors the Company decided that a future existed in the U.K. for the one trip light-weight mineral water bottle despite the initial success of canned soft drinks.

Indeed, Forster's welcomed this because the convenience of canned drinks had opened up many new retail outlets throughout the country for the sale of mineral waters. These outlets, Forster's believe, are now ready to retail a one trip bottle because it combines the convenience of a non-returnable container with the traditional consumer preference for glass. Results have shown Forster's to be correct.

U.S. Light-Weight Growth

The growth in popularity in America of the one trip mineral water bottle has been most marked. More and more of the leading bottlers have experimented with this bottle, notably Coca Cola in 1962. The retailer and consumer reaction to their one trip bottle is said to have been outstanding.

In fact, Smith L. Rairdon, an Executive Vice-President of Owens Illinois Glass Company said: "In 1962 the most important news was the continuing increase in the popularity of non-deposit bottles for beer and soft drinks."

The growth of popularity continues and Ernest L. Lowrie, Executive Vice-President of Squirt Company, U.S.A., is reported as estimating that by 1970 20% of soft drinks used will be of the one trip non-returnable kind.

The swing towards the one trip bottle has been marked in several recent surveys. One was carried out for the Glass Container Manufacturers Institute by Fred Sammis Research Unit in 1961. It indicated that 55% of consumers prefer buying mineral water in returnable bottles, 31% favoured the one trip bottle and only 14% cans. On the question of direct preference there is a 3 to 1 showing in favour of glass bottles over cans as the ideal container for soft drinks.

This trend is reflected in the most recent overall figures. In 1962, there were 11½ million gross cans produced for mineral waters and 3¼ million gross one trip bottles. The fact that the latter account already for nearly a third of can sales is significant when it is realised that cans were introduced much earlier.

A further factor of increasing importance in this field is that because of their higher carbonation most "mixer" drinks are more suitable for one trip bottles than cans. The "mixer" carbonation is between 4.5 and 5 volumes which is greater than the 4.2 volumes recommended by can manufacturers to-day as the maximum level.

One Trip Bottles Welcomed by U.S. Supermarkets

There is every indication that U.S. supermarkets have welcomed the one trip mineral water bottle and have, in turn, been partially responsible for its rapid growth.

They have come to regard one trip soft drinks as useful traffic builders in that their colourful presentation can effectively be used to ensure full exploitation of store space by attracting the consumer to hitherto dull areas. Along with this use of soft drinks to create new sales areas in supermarkets has gone an increasingly strict check on their profitable use of shelf space.

This American experience is of double value to the U.K. market, where, until quite recently, mineral waters were not available in supermarkets. Instead their major outlet has been the small retailer. He, however, is increasingly being ousted by the supermarket with its superior range of goods and presentation. This meant that the long-term sales of mineral waters would have been seriously impaired if the one trip bottle had not been introduced. Now, not only has this danger been averted but the much wider and larger sales opportunities offered by supermarkets have become available.

U.K. Users of Forster's One Trip Bottles

Forster's launched the first one trip light-weight mineral water bottle in the spring of 1962. This was used by Clayton Bros. to market a range of soft drinks under the "Swan Beverage" brand label. Since then, the following companies have started test-marketing the new bottle:—

The Aberdeen Mineral Water Co. Ltd., Aberdeen;
Robert Aitken & Co., Dunbar, Scotland;
Fenwick & Sons Ltd., Sunderland;
The Frodsham Mineral Water Co. Ltd., Frodsham, Cheshire;
The Guernsey Soft Drinks Co. Ltd., Channel Islands;
The Hampshire Mineral Water Co. Ltd., Southampton;
William Simpson Ltd., Walken, Nr. Manchester.
Storey & Sons Ltd., Newcastle.

In addition, the following two companies are currently test-marketing one trip mineral water bottles for their export trade:—

Cantrell & Cochrane Ltd., London;
John G. Webb & Co. Ltd., London.

One of the major reasons for the interest of these companies is the reasonable cost to the consumer of the one trip bottle, which, added to its convenience make it a very attractive proposition. The following figures taken from a test market last summer by one of the above companies clearly demonstrates this:—

Bottles	Price	Cost per Oz. to consumer
One trip 12 oz.	9d.	.75d. per oz.
Returnable 10 oz.	10d. (3d. deposit)	.7d per oz.

Range of One Trip Bottles

A further reason for the increasing acceptance of these bottles is that Forster's have produced them in a useful range of sizes:—

Bottle Size	One Trip Bottle Weight	Multi Trip Bottle Weight
7 oz.	5½ oz.	9¾ oz.
10 oz.	7 oz.	14 oz.
12 oz. "Glascan" ...	6¼ oz.	—
12 oz. Long-necked type	7½ oz.	—

The best known of these is the Forster's "Glascan". This is a squat ultra-light-weight 12—oz. bottle which is cheaper in terms of initial cost, packing and transport than the other Forster's 12—oz. bottle. It does, however, require some modification to existing bottling machines before it can be used, but the cost of this is soon recovered by reduced overheads in transport and the abolition of the process involved in the re-use of bottles.

Even including the cost of modification Forster's experience indicates that it is still cheaper to market soft drinks in a one trip bottle rather than in cans.

It is interesting to note that the 12—oz. size has been produced especially for one trip usage.

Marketing Advantages

The major advantages of the one trip bottle over both cans and returnable containers are three-fold — Display, Additional Retail Outlets, and Consumer Convenience of Purchase:—

I. Display — The Major consumer advantage of displaying bottled soft drinks in contrast with canned is that the natural product appearance has a much stronger sales appeal than any label can provide.

II. Additional Retail Outlets — the introduction of the one trip soft drinks bottle has meant that many more retailers — and especially the larger outlets, including supermarkets — have started to sell soft drinks. This is not only because of the elimination of the inconvenience of returns. It is also due to the fact that it gives to many retailers a much wider range of products to offer, which are in themselves both attractive and increasingly popular to the consumer.

III. Consumer Convenience of Purchase — As it becomes easier for the retailer to stock soft drinks, it is also simpler for the housewife to make impulse purchases of them without having to worry about her deposit charge. Also, one of the major trends in this field has been the production of multiple packs. These enable the housewife to take home a week's supply with no more concern then if she were purchasing sugar.

The Future

All in all, the advantages of the one trip light-weight mineral water bottle could give the soft drinks industry one of the greatest sales boosts ever. Even though it is still in test market there can be little doubt of its initial success. However, if the fullest benefit is to be enjoyed by the soft drinks industry it would be desirable if the advantages of the new bottle were promoted nationally.

The results of this could be highly beneficial to the industry. Traditionally, the major drawback to the development of soft drinks in the U.K. has been the deposit charge. The removal of this could give an entirely fresh appeal to soft drinks and so increase consumption.

Without this promotion the habit of buying one trip bottles will grow but it is questionable whether the overall benefits to the industry will be as great.

This is a matter the whole of the Soft Drinks Industry should consider very seriously as prompt action could bring great rewards.

APPENDIX VI

Reprinted from Packaging News, May 1965

FORSTER'S GLASS

The success of a standard ½—gal. glass jug designed to form a sales-compelling package for cider — following the transatlantic tendency towards the use of "party size" bottles — convinced Forster's Glass Co. Ltd. that the same reception would be accorded to a container of similar size for beer. Backing their own judgement, though at that time without a single order, they produced a ½—gal. jug with a particularly attractive shape for this special purpose, able to withstand the internal pressure developed during carbonation and/or pasteurisation, which was by no means an easy task.

That their faith was well-founded is now proven, however, because since its introduction towards the end of 1964 the jug has been adopted by Cobb & Co. Ltd. of Margate; J.W. Lees Ltd. of Manchester; Greene, King & Co. Ltd. of Bury St. Edmunds; and Threlfalls Chesters Ltd. of Liverpool and Manchester.

Made from the amber glass that has for many years been associated with beer bottles, Forster's ½—gal. jug is individual in every respect. It has an easy-to-hold handle which follows smoothly the general bottle outline and an easily removed screw cap which, when removed, shows the bottle is as comfortable to pour from as it is good to look at. So pleasing is the shape, in fact, that although the brewers demand a deposit this frequently remains unclaimed by the customer, who prefers to keep so handsome a pack for other purposes. The jug, which was an idea of Forster's commercial manager, Mr. A.H. Monaghan, is unique in the company's history in that it was developed entirely by the company's own technicians, the sales staff working subsequently to create a market that they were convinced must exist in the brewing industry. Today, all the users report a good response from retailers and consumers alike, so that a steadily growing market is anticipated. This is only one of the many developments, however, that Forster's have introduced to the glass container industry in the past few years, for they can justly lay claim to many "firsts".

The company was founded in St. Helens, Lancs., in 1878 as general engineers. By 1900, it had begun to manufacture glass bottles, and in 1919 the concern became a public company under its present name. Today, with Sir Charles Ponsonby as chairman (a position he has held since 1937), the day-to-day operations are carried out by a management team consisting of Mr. A.D. Morris, secretary and chief accountant; Mr. M.J. Hinds, works manager; and Mr. Albert H. Monaghan, commercial manager, under the active chairmanship of Mr. E.G. Turner, deputy chairman, who is also chairman of the engineering company of Ames Crosta Mills Co. Ltd. of Heywood, Lancs., chairman of the Geigy Group of companies in the U.K. and a member of the board of Manbre & Garton Ltd., makers of sugar, glucose and starch products.

Slow but steady expansion in the pre-war years was followed by a 10 year development plan, carried out between 1954 and 1963, which involved the complete reconstruction of the St. Helens works. Today the company is equipped with some of the most modern bottle making machinery in the world. This includes a number of IS (independent section) machines, able to produce high quality containers both narrow and wide mouthed. To support these machines, Forster's have introduced ultra-modern feeding equipment which provides for the automatic control of glass levels and temperatures before the molten glass is delivered to the bottle-making stations. That equipment has made it possible for Forster's to take a leading role in the production of light-weight containers.

First with full quality control

The company was the first in the U.K. to set up a full-scale quality control department and the first to apply statistical methods to the maintenance of production efficiency. The use of statistical techniques for the control of bottle dimensions and bore measurements, when introduced by Forster's, were unique in the industry. The department operates for 168 hours a week, carrying out systematic checks on the ware leaving the annealing lehrs for thermal shock resistance, glass distribution, internal pressure retention and capacity. Vitally important, too, are the

quality control departments sampling checks on bottles passed by the inspection department.

The largest single project ever undertaken by the company was the erection, at the end of 1962, of the first fully automatic batch mixing plant to go into operation in the U.K. This vast installation, which was described in detail in Packing News in May 1963, enables raw materials to be mixed far more accurately and speedily than was previously possible, allowing the plant output to be increased and the fullest benefit to be obtained from the new production machines. Each batch is mixed to a predetermined formula, to provide maximum homogeneity and the consistency essential to the production of efficient, reliable, light-weight glass containers.

Quick to profit from the possibilities introduced by the automatic batch mixing plant, Forster's pressed ahead with light-weighting and in several instances were able to lead the field. In 1962, for example, they co-operated with Clayton Bros. of London to launch non-returnable bottles for carbonated soft drinks. The bottle used was a stubby 12—oz. capacity container that is now familiarly referred to as the "Forster Glascan". It has been followed by several other shapes and sizes (7 oz., 10 oz., and 12 oz.), all of which have been welcomed by the bottlers not only for general distribution in the U.K. but also for export and for ships' stores.

First with light-weight for sterilized milk.

Forster's were also first in the field with lighter weight milk bottles for sterilized milk, achieving a 2 oz. drop in bottle weight, a lesser diameter, a lower initial cost and making possible a speeding up of the sterilization process. These advantages would not be possible, say Forster's, without tightly controlled glass distribution. That they are real is shown by the fact that, following searching trials by two leading dairy organisations, the Forster's bottle has been adopted by Associated Dairies Ltd. of Leeds and Newcastle; Bristol Dairies Ltd.; Coast Creamery Ltd. of Whitley Bay; Lancashire Hygenic Dairies Ltd. of Manchester; Northern Dairies Ltd. of Hull and South Eastern Farmers Ltd. of Headcorn, Kent.

Last year, after further experimentation and research, Forster's produced the first-ever standard quart bottle for sherry with a weight of only 17 oz., which represented a 3 oz. reduction and, as a main advantage, lower costs. Many users, however, have welcomed the weight reduction as a means of easing handling problems, particularly with full cases of filled 1 qt. bottles. Although this is a relatively new development, the lighter weight quart has been adopted by a number of bottling houses, including several breweries' wines and spirits departments. Made in amber glass, it follows closely the traditional wine bottle outline, with height and diameter reductions of only 0.313 in. and 0.142 in. respectively, so there is no obvious disparity in size despite the 3 oz. saving in overall weight. This bottle is available with a cork mouth or a "roll on" closure finish.

Department's 'flair' for originality

The company has profited greatly from its design department's flair for originality, which is excellently illustrated by the production of the Nescafe Super Sifter package — an attractive glass jar with a perforated, chromium-plated metal screw cap so that, when it is emptied of its original contents, it makes a useful kitchen container as a flour sifter, sugar or salt sprinkler. Several U.K. glass container manufacturers were briefed to produce designs for this Nescafe enterprise, combining, it was said, maximum attractiveness and dimensions consistent with handling on the company's existing filling and labelling machinery. Although Forster's are primarily makers of bottles and jars, the cleanly moulded Nescafe sifter was complimented by Nestles as bearing comparison with many examples of domestic glassware.

A good example of the achievement possible when the glass container maker works in close collaboration with the packer is the 10-oz. jar produced by Forster's for Tiptree preserves. Clean and modern in design to ensure maximum appeal without excessive production costs, the jar and its closure (manufactured by Thomas Hunter Ltd., Rugby) provide for an initial vacuum seal and easy re-closure by the housewife. The ring finish is designed to resist chipping and for easy cleaning in the event of an overspill at the filling point.

Forster's possess, it is said, an unusually efficient glass decorating department, largely engaged of course in the production of beer, milk and mineral water bottles with permanent fired-in labels. Their skill in this field is shown by their development of the first enamel finish bottle to be used in this country by S.C. Johnson Ltd. Providing a new presentation for that

company's Liquid One Step car polish, it has a greater impact than can be obtained with a paper label because of the strong colours that can be used. Johnson's brief to the Forster's glass design unit demanded full continuity of consumer recognition so that maximum use was made of the main features of the original design while exploiting to the full the opportunities presented by the new decorative technique. Using red, yellow and white against the clear amber glass background of the bottle, Forster's have given the product a new standard of sales appeal that has been amply proven by results. It is impossible for a fired-in enamel print to be defaced, torn or displaced, so that the bottle remains attractive in appearance throughout its life because its colours cannot fade.

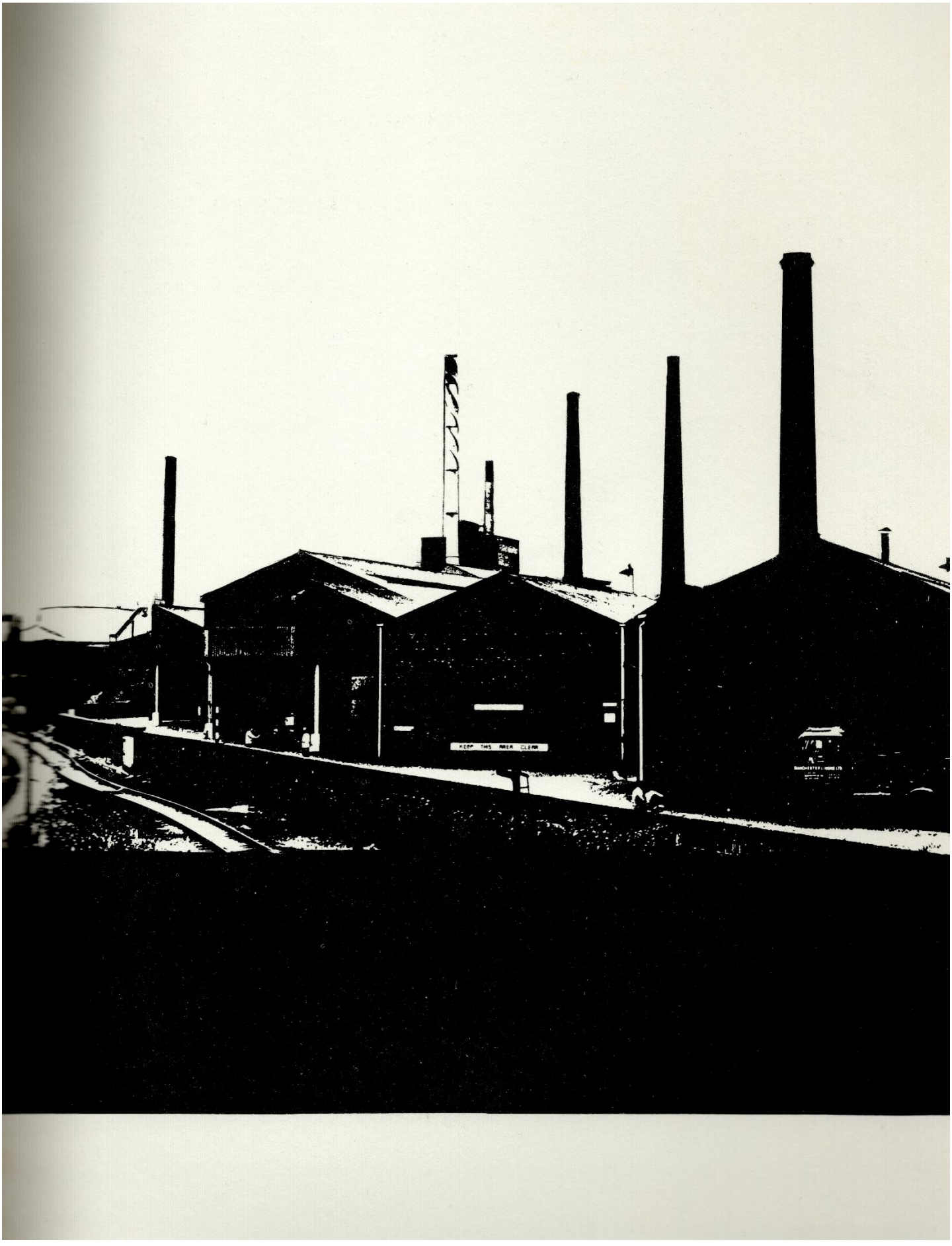
Approximately 60 per cent of the output of the glass decorating department is exported, say Forster's, who are justly proud of their position as the largest single exporter of glass bottles from the U.K.

Containers of all kinds are shipped all over the world, though the market is an extremely tough one and competition is being faced from Germany and Holland as well as several East European countries.

APPENDIX VII

SIGNIFICANT DATES

1878	D. & J. Forster	A Private Company involved in Engineering
1880	John Forster and Company	A Private Company involved in Engineering
1893	John Forster and Company Limited	A Private Company involved in Engineering
1905	Forster & Sons Limited	A Private Company involved in the manufacture of glass containers.
1919	Forster's Glass Company Limited	A Public Company involved in the manufacture of glass containers.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